(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
28 October 2004 (28.10.2004)

PCT

(10) International Publication Number
WO 2004/092519 A1

(51) International Patent Classification[7]: E05F 15/20

(21) International Application Number:
PCT/KR2003/002533

(22) International Filing Date:
21 November 2003 (21.11.2003)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
10-2003-0024121 16 April 2003 (16.04.2003) KR
10-2003-0026614 26 April 2003 (26.04.2003) KR

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(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,

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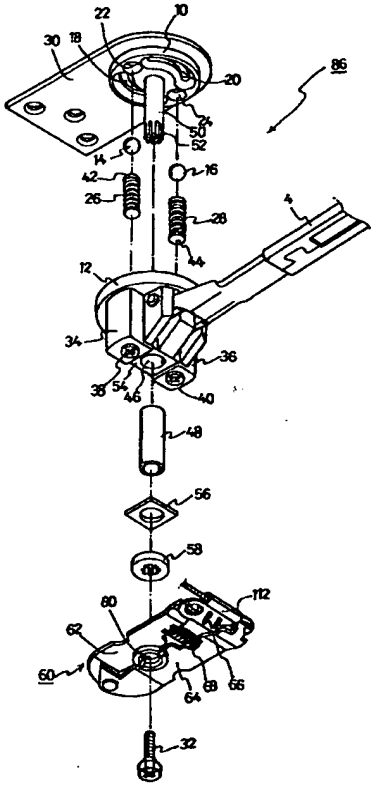
(54) Title: APPARATUS FOR OPERATING DOOR TO PREVENT SPREAD OF FIRE AND METHOD THEREFOR



(57) Abstract: A door operating apparatus for prevention of the spread of a fire including a door closer for performing an automatic door closing function, a fume sensor for generating a fume sensing signal when fumes are sensed, a heat sensor for generating a temperature sensing signal when an ambient temperature does not reach a first predetermined temperature for automatically releasing a latched state of a door, but reaches a second predetermined temperature lower than the first predetermined temperature, the second predetermined temperature representing an initial fire stage, and a door latching device for latching the door in an opened state, and releasing the latched state of the door in response to the ambient temperature when the ambient temperature reaches the first predetermined temperature due to the fire, while forcibly releasing the latched state of the door by an operating voltage applied thereto based on at least one of the sensing signals.

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ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:

— *with international search report*

APPARATUS FOR OPERATING DOOR TO PREVENT SPREAD OF FIRE AND METHOD THEREFOR

Technical Field

The present invention relates to a fireproofing system, and more particularly to a door operating apparatus and an operating method thereof which are adapted to prevent the spread of a fire.

Background Art

Door closers have a function for automatically closing a door while latching the door at an opening angle desired by the user. In accordance with an application thereof, such door closers are classified into a general door closer and a fireproofing door closer. Such door closers are widely used in a state of being installed at a general door or a fireproofing door.

Recently, many large complexes have been constructed. Nowadays, there are also large department stores, and buildings exhibiting a high density of mobile population. For this reason, a fire which breaks out at such large buildings may become a conflagration. Therefore, construction of a fireproofing system in such large buildings has become very important. In this regard, most nations have established

strict regulations in association with fireproofing systems. Generally, noxious gases and fumes generated when a fire breaks out may cause a great loss of lives. Many people may be killed in a fire due to the fact that they cannot find an emergency exit.

Regulations established in association with construction of fireproofing systems include regulations associated with fireproofing doors. In the regulations established in Korea in association with fireproofing doors, it is stipulated that the fireproofing door should be structured to be maintained in a closed state or to be automatically closed in response to generation of fumes or an increase in temperature. Similar regulations have been established in other nations. In order to maintain a fireproofing door in a closed state, locking of the fireproofing door is the best method in terms of the management of the fireproofing door. However, this method not only conflicts with the purpose of the fireproofing door, but also puts users at an inconvenience. In order to solve such problems, various fireproofing door closers and automatic closing devices for fireproofing doors have been developed which serve to automatically close an opened fireproofing door when generation of fumes or an increase in temperature occurs due to a fire.

However, fireproofing systems and apparatuses recently developed to prevent the spread of a fire are not only very expensive, but also have a degraded reliability in detecting a

fire. In the case of a fireproofing system adapted to detect a fire through detection of fumes, an erroneous operation thereof may occur when there is cigarette smoke near a fume sensor. Such a fireproofing system may also operate erroneously after particulates such as dust accumulate on the fume sensor for several months. Accordingly, it is necessary to clean the fume sensor at intervals of several months. For this reason, the fireproofing system using the fume sensor to detect a fire exhibits a degradation in reliability caused by frequent erroneous operations. Many users who use such a fireproofing system have appealed to the manufacturers to solve problems caused by an erroneous operation of the fireproofing system. In particular, when the fireproofing system operates erroneously, it may close not only fireproofing doors, but also fireproofing shutters while operating sprinklers. In such a situation, delay or failure of business may occur.

Meanwhile, in the case of a fireproofing system adapted to detect a fire through detection of heat, a door latching device including a heat sensitive fuse is used. When the ambient temperature around the door latching device, which is installed at a door, increases over a predetermined temperature as a fire breaks out, the heat sensitive fuse included in the door latching device is fused, thereby causing the door maintained in an opened state by the door latching device to be automatically closed by a door closing device

such as a door closer. However, considerable costs are taken to construct such a fireproofing system adapted to close a fireproofing door when a fire beaks out. As the door is repeatedly opened and closed, the door latching device or the heat sensitive fuse included therein may be worn. As a result, the door latching device may not operate even though a fire beaks out.

An example of a door closer adapted to solve the above mentioned problems is disclosed in U.S. Patent No. 6,092,334 issued on July 25, 2000 in the name of Young Jo Kim who is the inventor of the present invention and entitled "DOOR LOCKING DEVICE FOR A DOOR CLOSER HAVING A FIRE ACTUATED MECHANISM FOR UNLOCKING THE DOOR LOCKING DEVICE". The door locking device disclosed in U.S. Patent No. 6,092,334 has a function for automatically closing a door and a function for locking (latching) the door at a desired opening angle. In addition to such conventional functions, this door locking device is operatively connected to a general door closer installed at a general door and/or a fireproofing door. In accordance with such a configuration, when a fire breaks out, a heat sensitive fuse included in the door locking device is fused, so that the door locking device allows the door to be automatically closed by the door closer even under the condition in which the door is latched in its opened state by the door locking device.

However, the door locking device disclosed in U.S. Patent No. 6,092,334 has a drawback in that it cannot rapidly

cope with a fire. Although the door is closed when the ambient temperature around the door locking device increases to a predetermined temperature, noxious gases and fumes generated when the fire breaks out have already spread over a sufficiently large area through the door, prior to the closing of the door. Furthermore, most conventional fireproofing systems and apparatuses operating through sensing of fumes or heat are centrally controlled in a building manager's room. For this reason, it is difficult to rapidly cope with damage to lives by noxious gases and fumes rapidly spreading when a fire breaks out.

Therefore, it is necessary to provide a fireproofing system which is inexpensive while being capable of reliably detecting a fire, and closing a fireproofing door or a general door at an initial stage of the fire in order to prevent the spread of a fire.

Disclosure of the Invention

Therefore, an object of the invention is to provide a door operating apparatus and an operating method thereof which are capable of preventing the spread of a fire at an initial stage of the fire while ensuring the reliability of a door closer for closing the door.

Another object of the invention is to provide a door operating apparatus an operating method thereof which are

capable of reliably performing a door closing function when a fire breaks out.

Another object of the invention is to provide a door operating apparatus for prevention of the spread of a fire and an operating method thereof which can rapidly shut off a fire spread path at an initial stage of the fire, while being capable of raising an alarm, and providing guidance to shelter.

Another object of the invention is to provide a door operating apparatus and an operating method thereof which can minimize erroneous fire detection to ensure a high operation reliability, while being capable of preventing the spread of a fire at an initial stage of the fire.

Another object of the invention is to provide a door operating apparatus and an operating method thereof which can rapidly detect a fire and rapidly cope with the spread of the fire, based on a raid determination of the user or manager.

Another object of the invention is to provide a door operating apparatus and an operating method thereof which can prevent generation of costs, inconvenience, and troublesomeness caused by an erroneous operation thereof caused by an erroneous fire detection thereof.

Another object of the invention is to provide a door operating apparatus and an operating method thereof which can reduce the installation and management costs of a fireproofing system.

In accordance with one aspect, the present invention provides a door operating apparatus for prevention of the spread of a fire, comprising: a door closer for performing an automatic door closing function; a fume sensor for sensing fumes caused by a fire, and generating a fume sensing signal when a predetermined fume concentration is sensed; a heat sensor for sensing an ambient temperature, and generating a temperature sensing signal when the ambient temperature does not reach a first predetermined temperature for automatically releasing a latched state of a door to cope with a fire, but reaches a second predetermined temperature lower than the first predetermined temperature, the second predetermined temperature representing an initial stage of the fire; and a door latching device operatively connected to the door closer, and adapted to latch the door at an opening position desired by a user, the door latching device releasing the latched state of the door in response to the ambient temperature when the ambient temperature reaches the first predetermined temperature due to the fire, while forcibly releasing the latched state of the door by an operating voltage applied thereto in accordance with at least one of the fume sensing signal from the fume sensor and the temperature sensing signal from the heat sensor.

In accordance with another aspect, the present invention provides a method for operating a door operating apparatus for prevention of the spread of a fire including a door closer for

performing an automatic door closing function, and a door latching device operatively connected to the door closer, and adapted to latch the door at a desired opening position, the door latching device releasing the latched state of the door in accordance with fusing of a heat sensitive fuse, included therein, carried out in response to an ambient temperature when the ambient temperature reaches a first predetermined temperature due to a fire, the method comprising the steps of: sensing fumes caused by the fire, and generating a fume sensing signal when a predetermined fume concentration is sensed; sensing the ambient temperature, and generating a temperature sensing signal when the ambient temperature increasing due to the fire reaches a second predetermined temperature lower than the first predetermined temperature; and receiving an operating voltage in accordance with at least one of the fume sensing signal and the temperature sensing signal, and forcibly fusing the heat sensitive fuse by the received operating voltage, thereby releasing the door latching state of the door latching device.

In accordance with another aspect, the present invention provides a door operating apparatus for prevention of the spread of a fire comprising an automatic door closing device adapted to perform a function for automatically closing a door, further comprising: a fume sensor unit for sensing fumes caused by the fire, and generating a fume sensing signal when a predetermined fume concentration is sensed; a first switch

for selectively supplying an operating voltage in accordance with the fume sensing signal from the fume sensor unit; an alarm device adapted to be driven by the operating voltage applied thereto via the first switch, thereby outputting an alarm warning of the fire; a heat sensor unit adapted to be activated by the operating voltage applied thereto via the first switch to sense an ambient temperature, the heat sensor unit generating a temperature sensing signal when the ambient temperature does not reach a first predetermined temperature for naturally releasing a latched state of the door to cope with the fire, but reaches a second predetermined temperature lower than the first predetermined temperature due to the fire, the second predetermined temperature representing an initial stage of the fire; a second switch for selectively supplying the operating voltage applied thereto via the first switch, in accordance with the temperature sensing signal from the heat sensor unit; and a door latching releasing unit for latching the door in an opened state while releasing the latched state of the opened door by the operating voltage applied thereto via the second switch, thereby causing the door to be automatically closed, the door latching releasing unit also releasing the latched state of the door when the ambient temperature reaches the first predetermined temperature due to the fire, thereby allowing the door to be automatically closed by the automatic door closing device.

In accordance with another aspect, the present invention

provides a method for operating, for prevention of the spread of a fire, a door closer assembly including an automatic door closing device adapted to perform a function for automatically closing a door, a fume sensor adapted to sense fumes, a heat sensor adapted to sense heat, and a door latching device adapted to latch the door in an opened state, and to release the latched state of the opened door, the door latching device including a heat sensitive fuse, the method comprising the steps of: generating a message warning of a fire when the fume sensor senses fumes, while simultaneously activating the heat sensor; forcibly fusing the heat sensitive fuse of the door latching device when the heat sensor does not sense a first predetermined temperature, at which the heat sensitive fuse is naturally fused, but senses a second predetermined temperature lower than the first predetermined temperature, thereby releasing the latched state of the door to allow the door to be closed by the automatic door closing device; and making the door latching device release the latched state of the door when the heat sensitive fuse of the door latching device is naturally fused as an ambient temperature reaches the first predetermined temperature due to a fire, thereby allowing the door to be automatically closed by the automatic door closing device.

Brief Description of the Drawings

FIG. 1 is a view illustrating the closed state of a door at which a door closer assembly according to an embodiment of the present invention is installed;

FIG. 2 is an exploded perspective view of a door latching device included in the door closer assembly shown in FIG. 1, illustrating a configuration in which a fuse heat is included in a heat sensitive fuse assembly in accordance with an embodiment of the present invention;

FIG. 3 is a perspective view concretely illustrating the heat sensitive fuse assembly according to the embodiment of the present invention shown in FIG. 2;

FIG. 4 is an exploded perspective view illustrating the fuse heater for the heat sensitive fuse shown in FIGS. 2 and 3, along with upper and lower pieces included in the heat sensitive fuse;

FIG. 5A is a partially sectional view illustrating the fuse heater held by the upper and lower pieces of the heat sensitive fuse of FIG. 4;

FIG. 5B is a cross-sectional view taken along the line A - A' of FIG. 5A;

FIG. 6 is a sectional view illustrating the fuse heater according to the embodiment of the present invention;

FIG. 7 is a circuit diagram illustrating a control circuit included in a door operating device for prevention of the spread of a fire in accordance with an embodiment of the present invention;

FIGS. 8A and 8B are schematic views illustrating elements of an electrical circuit for prevention of the spread of a fire in accordance with an embodiment of the present invention;

FIG. 9 is a flow chart illustrating a method for releasing the door latching state of the door closer assembly having the circuit configuration shown in FIG. 7

FIGS. 10A and 10B are schematic views respectively illustrating various types of a door operating apparatus for prevention of the spread of a fire;

FIG. 11 is a circuit diagram illustrating another example of the control circuit included in the door operating device for prevention of the spread of a fire according to the embodiment of the present invention;

FIG. 12 is a circuit diagram illustrating a control circuit included in a door operating apparatus for prevention of the spread of a fire which is of a latch type in accordance with an embodiment of the present invention;

FIG. 13 is a flow chart illustrating a method for releasing the latched state of a door in the door operating apparatus for prevention of the spread of a fire according to FIG. 11 or 12;

FIG. 14 is a flow chart illustrating an operation of the door operating apparatus in which the heat sensor of FIG. 11 or 12 is replaced by a fume sensor to implement a double fume sensor configuration including first and second fume sensors;

and

FIG. 15 is a flow chart illustrating an operation of the door operating apparatus in which the fume sensor of FIG. 11 or 12 is replaced by a heat sensor to implement a double fume sensor configuration including first and second heat sensors.

Best Mode for Carrying Out the Invention

Now, preferred embodiments of the present invention will be described in detail with reference to the annexed drawings. In the annexed drawings, the same or similar elements are designated by the same reference numerals even though they are depicted in different drawings. In the following description of the present invention, a detailed description of known functions and configurations incorporated herein will be omitted when it may make the subject matter of the present invention rather unclear.

Described in the following embodiments of the present invention are examples in which the present invention is applied to a door closer assembly installable at any door, for example, either of a general door or a fireproofing door, while including a door latching device manufacturable separately from a general door closer. The door closer assembly, which will be exemplarily described hereinafter, has advantages of low manufacturing costs and a high reliability. It will be appreciated by those skilled in the art that

although the present invention will be described in conjunction with such a door closer assembly, it is not limited by the door closer assembly.

FIG. 1 is a view illustrating the closed state of a door at which a door closer assembly according to an embodiment of the present invention is installed. Referring to FIG. 1, a door closer assembly is illustrated in which a door latching device 86 and a general door closer 2 are operatively connected to each other via an arm 4.

In the following embodiments of the present invention, the configuration, which includes the general door closer 2, arm 4, and door latching device 86, will be referred to as a "door closer assembly". The door closer 2, which is included in such a door closer assembly, is an example of a device for performing an automatic door closing function. For other examples of such an automatic door closing device, there are an auto hinge and a floor hinge.

Referring to FIG. 1, the general door closer 2, which performs an automatic door closing function, is mounted to the door 78. The door latching device 86 is connected to one end of the arm 4 connected at the other end thereof to the door closer 2, so that it is operatively connected to the door closer 2. The door latching device 86 is fixed to the low surface of the upper end of a doorframe 8 fixedly mounted to a wall 84. The door latching device 86 has a function for latching the door 78 at an opening angle desired by the user.

The door latching device 86 also has a function for releasing the condition of the door 78 latched in an opened state when a fire breaks out, thereby allowing the door 78 to be immediately automatically closed by the door closer 2. For this function, the door latching device 86 includes a heat sensitive fuse adapted to be naturally (mechanically) fused when the ambient temperature around the door latching device 86 increases to about 72°C ± 2°C as a fire breaks out, thereby causing the door latching device 86 to release its condition of latching the door 78 in an opened state. Thus, the door 78 can be immediately automatically closed by the door closer 2 when a fire breaks out.

FIG. 2 is an exploded perspective view illustrating the door latching device 86 included in the door closer assembly according to the embodiment of the present invention shown in FIG. 1. As shown in FIG. 2, the door latching device 86 includes a heat sensitive fuse assembly 60. This heat sensitive fuse assembly 60 includes a heat sensitive fuse 66 adapted to be naturally fused when the ambient temperature therearound reaches about 72°C ± 2°C, and a fuse heater 112 adapted to forcibly fuse the heat sensitive fuse 66 in accordance with a certain control operation under the condition in which the ambient temperature around the heat sensitive fuse 66 has not reached about 72°C ± 2°C yet.

Referring to FIG. 2, the door latching device 86, which is connected to the arm 4 of the general door closer 2 shown

in FIG. 1, includes a support member 10 fixedly mounted to the doorframe 8, and a rotating member 12 rotatably coupled to the support member 10. A pair of engagement balls 14 and 16 are elastically mounted to the upper surface of the rotating member 12 by means of springs 26 and 28, respectively. The support member 10 is provided at a lower surface thereof with a pair of facing arc-shaped guide grooves 18 and 20 extending in a circumferential direction of the support member 10, and a pair of facing engagement grooves 22 and 24. The guide grooves 18 and 20 and engagement grooves 22 and 24 are alternately arranged. When the rotating member 12 rotates with respect to the support member 10, the engagement balls 14 and 16 slide along the guide grooves 18 and 20 and the engagement grooves 22 and 24 in a sequential fashion. As a result, the latching and releasing operations of the door latching device 86 are alternately carried out.

The door latching device 86 also includes a fixing member 30 coupled to the support member 10 in a state in which the angular position of the fixing member 30 with respect to the support member 10 is adjustable. The fixing member 30 is mounted to the upper end of the doorframe 8 so as to mount the door latching device to the doorframe 8.

The rotating member 12 is also provided with spring chambers 34 and 36 adapted to receive respective springs 26 and 28 therein. Each of the spring chambers 34 and 36 is closed at its lower end while being opened at its upper end.

Adjustment bolts 38 and 40 are threadedly coupled to threaded holes formed at respective lower ends of the spring chambers 34 and 36 such that they are protruded into the spring chambers 34 and 36, respectively. Frictional plates 42 and 44 are mounted to the upper and lower ends of each spring 26 or 28, respectively. The frictional plates 42 and 44 are in contact with the associated engagement ball 14 or 16 and the adjustment bolt 38 or 40. A through hole 46 having a desired diameter extends vertically through a central portion of the rotating member 12. A support tube 48 having a desired diameter and a desired length is loosely fitted in the through hole 46. The rotating member 12 is also provided at one side portion thereof with a means for connecting the arm 4 to the rotating member 12. The rotating member 12 is also formed at its upper surface with a coupling recess for receiving the support member 10.

The support member 10 has an appropriate diameter and thickness so that it is loosely fitted in the coupling recess formed at the upper surface of the rotating member 12. The support member 10 is centrally formed with a through hole. Although not shown, the support member 10 is also centrally provided at its upper surface with teeth formed to extend radially around the central through hole of the support member 10 in accordance with a knurling process. An elongated threaded tube 50 having an appropriate diameter extends downwardly from the lower surface of the fixing member 30.

The threaded tube 50 has threads at its inner surface. When the fixing plate 30 is coupled with the support member 10, the threaded tube 50 extends through the central through hole of the support member 10. The threaded tube 50 is provided with a splined portion 52 at its lower end. The rotating member 12 is centrally provided at its lower surface with an angular groove 54 arranged around the through hole 46. A busing 56 is fitted in the angular groove 54. In an assembling procedure, a boss 58 is coupled to the splined portion 52 of the threaded tube 50 protruded through the busing 56. Thereafter, a fastening bolt 32 is threadedly coupled to the threaded tube 52.

In accordance with this configuration, there is no possibility that the fastening bolt 32 is loosened during the rotation of the rotating member 12. Accordingly, the door latching device can be reliably used without any inconvenience because it is unnecessary to frequently fasten the fastening bolt 32. During the rotation of the rotating member 12, a friction occurs between the rotating member 12 and the boss 58. However, since the rotating member 12 is in indirect contact with the boss 58 via the busing 56, it is not worn during its rotation. In place, the busing 56 and boss 58 may be worn. Accordingly, if the busing 56 and boss 58 are made of a material having a high strength, the rotating member 12 can be semi-permanently used without any replacement of those elements. Although the busing 56 or boss 58 may be

excessively worn after prolonged use thereof, it is only necessary to replace the worn element with a new one, without replacement of the rotating member 12. Thus, it is possible to reduce the replacement costs.

Prior to the fastening of the fastening bolt 32, the angular position of the fixing member 30 with respect to the support member 10 is adjusted to define a desired angle between the fixing member 30 and the support member 10 corresponding to a desired latching angle of the door. After this adjustment, the fastening bolt 32 is fastened, so that the teeth of the support member 10 and the teeth of the fixing member 30 are engaged with each other, thereby causing the support member 10 and fixing member 30 to be firmly coupled to each other. Each of the springs 26 and 28 adapted to elastically support the engagement balls 14 and 16 has an appropriate length in an uncompressed state. The support tube 48 also has an appropriate length so that it can prevent the rotating member 12 from coming into contact with the support member 10. Accordingly, there is no problem even when the fastening bolt 32 is strongly fastened. Of course, the resilience of the springs 26 and 28 adapted to maintain the engagement balls 14 and 16 in an engaged state can be appropriately adjusted by fastening or loosening the adjustment bolts 38 and 40.

Where it is desired to provide a fireproofing function to the door latching device 86, the heat sensitive fuse

assembly 60 is coupled to the door latching device 86. That is, the heat sensitive fuse assembly 60 is slightly loosely coupled to the fastening bolt 32 such that the fastening bolt 32 extends through a coupling hole 80 formed at the heat sensitive fuse assembly 60. In this state, the fastening bolt 32 is coupled to the threaded tube 50 of the fixing member 50. Thus, the heat sensitive fuse assembly 60 is coupled to the door latching device 86.

The heat sensitive fuse assembly 60 includes a pair of support pieces 62 and 64 hingably coupled to each other at their one-side ends, and defined with the coupling hole 80 therebetween in the coupled state thereof, a heat sensitive fuse 66 adapted to connect the other-side ends of the support pieces 62 and 64, and a spring 68 arranged between the support pieces 62 and 64, and adapted to always urge the support pieces 62 and 64 to hingably move away from each other. The heat sensitive fuse 66 is adapted to be fused when the temperature thereof increases to about 72°C ± 2°C due to, for example, a fire. When the heat sensitive fuse 66 is fused, the support pieces 62 and 64 are hingably moved away from each other by virtue of the resilience of the spring 68, so that they are separated from the door latching device 86. As a result, a clearance corresponding to the thickness of the heat sensitive fuse assembly 60 separated from the door latching device 86 is obtained at the door latching device 86. By virtue of this clearance, the fastening bolt 32 is rendered to

be in a state of being loosened in an amount corresponding to the clearance, so that the resilience of the springs 26 and 28 received in the spring chambers 34 and 36 is correspondingly reduced. Accordingly, the latched state of the door is automatically released.

In the illustrated embodiment of the present invention, the heat sensitive fuse assembly 60 also includes a fuse heater 112 attached to the heat sensitive fuse 66, and a fume sensor or heat sensor. When the fume sensor or heat sensor senses noxious gases or fumes generated at an initial stage of a fire or a predetermined temperature (heat) lower than the natural fusing temperature of the heat sensitive fuse 66, that is, about 72°C ± 2°C, it operates to supply an operating voltage to the fuse heater 112. As a result, the fuse heater 112 heats the heat sensitive fuse 66, thereby causing the heat sensitive fuse 66 to be forcibly fused. In this case, the heat sensitive fuse assembly 60 is separated from its original position on the door latching device 86 at an initial stage of the fire, so that the door latching device 86 automatically releases the latched state of the door in the same manner as described above.

The heat sensitive fuse assembly 60 having the above described configuration according to the illustrated embodiment of the present invention completely eliminates a problem involved with a conventional mechanical heat sensitive fuse, that is, a problem caused by a wear of such conventional

mechanical heat sensitive fuse. After a door, to which a conventional mechanical heat sensitive fuse is mounted, is repeatedly opened and closed, the conventional mechanical heat sensitive fuse is worn, so that it may not operate normally in response to an increase in the ambient temperature therearound. However, the heat sensitive fuse assembly 60 according to the illustrated embodiment of the present invention has a structure in which no wear is generated even after the door is repeatedly opened and closed. Accordingly, the heat sensitive fuse of the heat sensitive fuse assembly 60 normally performs its mechanical heat sensing function. Also, the heat sensitive fuse assembly 60 can reliably sense fumes or heat at an initial stage of a fire, so that it can forcibly fuse the heat sensitive fuse 66. Thus, the heat sensitive fuse assembly 60 can reliably perform its fireproofing function for closing the door, thereby preventing the spread of a fire.

FIG. 3 is a perspective view concretely illustrating the heat sensitive fuse assembly 60 according to the embodiment of the present invention shown in FIG. 2. FIG. 4 is an exploded perspective view illustrating the fuse heater 112 for the heat sensitive fuse 66 shown in FIGS. 2 and 3, along with upper and lower pieces 100 and 102 included in the heat sensitive fuse 66.

Referring to FIGS. 3 and 4, the heat sensitive fuse 66 of the heat sensitive fuse assembly 60 according to the

illustrated embodiment of the present invention includes upper and lower pieces 100 and 102 bonded to each other by a solder adapted to melt when the ambient temperature therearound reaches a predetermined temperature, for example, about 72°C ± 2°C, due to, for example, a fire. The upper piece 100 has an engagement hole 104 for receiving an engagement hook 110 of the support piece 64 arranged at the right side in FIG. 3, whereas the lower piece 102 has an engagement hole 106 for receiving an engagement hook 108 of the support piece 62 arranged at the left side in FIG. 3. Accordingly, the support pieces 62 and 64 are engaged with the lower and upper pieces 110 and 108, respectively. Holders 114a and 114b extend from the upper and lower pieces 100 and 102 of the heat sensitive fuse 66, respectively, in order to hold the fuse heater 112. The fuse heater 112 held by the holders 114a and 114b generates heat when an operating voltage is applied thereto, thereby fusing the heat sensitive fuse 66.

In accordance with the illustrated embodiment of the present invention, the heat sensitive fuse 66 having the above described structure may be naturally fused when the ambient temperature therearound increases to a predetermined temperature of about 72°C ± 2°C due to a fire, or may be forcibly fused in accordance with a forcible heating operation carried out in response to sensing of fumes or heat, prior to the natural fusing thereof. This will be described in more detail. When the ambient temperature around the door closer

assembly gradually increases due to a fire, and reaches a temperature of about 72°C ± 2°C, the solder interposed between the upper and lower pieces 100 and 102 of the heat sensitive fuse 66 melts, so that the upper and lower pieces 100 and 102 are separated from each other. Thus, the heat sensitive fuse 66 is naturally fused. On the other hand, when noxious gases or fumes are sensed around the door closer assembly by an associated sensor, or a predetermined temperature of, for example, 50°C to 70°C (preferably, 60°C to 70°C), relatively lower than the melting temperature of the solder included in the heat sensitive fuse 66, that is, about 72°C ± 2°C, is sensed by an associated sensor, the fuse heater 112 heats up in accordance with an operating voltage supply control, thereby melting the solder interposed between the upper and lower pieces 100 and 102 of the heat sensitive fuse 66. Thus, the heat sensitive fuse 66 is forcibly fused. When the solder interposed between the upper and lower pieces 100 and 102 of the heat sensitive fuse 66 melts due to an increase in the ambient temperature therearound or in accordance with a forcible heating operation, the heat sensitive fuse 66 is fused. When the heat sensitive fuse 66 is fused, the heat sensitive fuse assembly 60 is immediately separated from its original position on the door latching device by virtue of the resilience of the spring 68, so that the latching state of the door latching device 86 is released.

In accordance with the illustrated embodiment of the

present invention, it is possible to close a fireproofing door or a general door at an initial stage of a fire by forcibly fusing the heat sensitive fuse 66 in response to sensing of heat and/or fumes by associated sensors, before the heat sensitive fuse 66 is naturally fused due to an increase in the ambient temperature caused by a fire. Accordingly, it is possible to prevent the spread of a fire and damage to lives by noxious gases and fumes.

Now, the structure for holding the fuse heater 112 adapted to forcibly fuse the heat sensitive fuse 66, and the inner structure of the fuse heater 112 will be described in detail with reference to FIGS. 5A, 5B, and 6.

FIG. 5A is a partially sectional view illustrating the fuse heater 112 held by the holders 114a and 114b of the upper and lower pieces 100 and 102 included in the heat sensitive fuse 66 of FIG. 4 in a state of being surrounded by the holders 114a and 114b. FIG. 5B is a cross-sectional view taken along the line A - A' of FIG. 5A. FIG. 6 is a sectional view illustrating the fuse heater 112 according to the illustrated embodiment of the present invention.

As shown in FIG. 5A, a lead line 118 extends from one end of the fuse heater 112. The lead line 118 is soldered to the lower piece 102 of the heat sensitive fuse 66 so that it is grounded. A voltage input line 116 is connected to the other end of the fuse heater 112. An operating voltage is applied to the voltage input line 116. As shown in FIG. 6,

the fuse heater 112 includes an outer tube 124 made of a copper material, a heater coil 120 received in the outer tube 124, and adapted to generate heat by an operating voltage applied thereto via the voltage input line 116, and an insulating bobbin 22 made of a ceramic material, and adapted to surround the heater coil 120. The heater coil 120 is connected with the lead line 118 and voltage input line 116 at opposite ends thereof while being sealed by insulating sleeves 126 made of a Teflon material, respectively. Each of the lead line 118 and voltage input line 116 includes a wire insulated by a chrysotile tube.

FIG. 7 illustrates a circuit configuration of the door closer according to the illustrated embodiment of the present invention for forcibly fusing the heat sensitive fuse 66 having the above described configuration, thereby preventing the spread of a fire at an early stage of the fire, that is, the spread of noxious gases or fumes generated due to the fire, and the spread of flames.

FIG. 7 is a circuit diagram illustrating a control circuit included in a door operating device for prevention of the spread of a fire in accordance with an embodiment of the present invention. The door operating device for prevention of the spread of a fire may be implemented by the above described door closer assembly. The control circuit shown in FIG. 7 senses noxious gases or fumes or the temperature of flames generated at an initial stage of a fire through a fume

sensor 208 or a heat sensor 210, and forcibly fuses the heat sensitive fuse 66 of the door latching device 86 by use of the fuse heater 112.

Referring to FIG. 7, the electrical circuit of the door closer assembly includes an operating voltage supply unit for supplying an operating voltage to the fuse heater 112. The operating voltage supply unit includes a transformer 202, which is a voltage transforming unit adapted to transform a commercial AC voltage 200 of 110V/220V into at least one predetermined voltage level, a rectifying diode 204 for rectifying the voltage transformed by the transformer 202, so as to supply the rectified voltage, that is, a DC voltage, as an operating voltage, and a battery 206 adapted to be charged by the DC voltage, and to supply the charged DC voltage as the operating voltage. The operating voltage supply unit has an advantage in that it can operate by the voltage supplied from the battery 206 when an external input voltage is cut off due to a fire. The commercial AC voltage 200 is transformed into predetermined AC voltage levels, for example, 24V, 12V, and 6V, by the transformer 202, half-wave-rectified by the rectifying diode 204, and then charged in the battery 206. The rectified voltages may also be directly supplied to associated electrical circuit elements.

The electrical circuit of the door closer assembly also includes a power switch PSW for switching on/off the supply of the operating voltage, a fuse FS, and a reset switch 207 for

turning off an alarm lamp and lamps for guidance to shelter while stopping generation of an alarm from a fire alarm device 214. The reset switch 207 may operate erroneously due to fumes. Where such an erroneous operation of the reset switch 207 occurs, the user may stop the generation of an alarm while turning off the alarm lamp by use of the power switch PSW.

The electrical circuit of the door closer assembly further includes the above described fume sensor 208 and heat sensor 210 in order to sense the spread of noxious gases and fumes generated due to a fire or flames of the fire. Although the electrical circuit includes both the fume sensor 208 and the heat sensor 210 in the case of FIG. 7, only one of the fume sensor 208 and heat sensor 201 may be selectively used. In this case, it is preferable to install the fume sensor 208, taking into consideration the fact that noxious gases and fumes are most rapidly spread when a fire breaks out.

The fume sensor 208 and heat sensor 210 receives the charged voltage from the battery 206 or the rectified operating voltage via the power switch PSW, fuse FS, and reset switch 207. The fume sensor 208 and heat sensor 210 are connected in parallel while being connected to a relay 212. Alternatively, the fume sensor 208 and heat sensor 201 may be connected in series. In this case, the relay 212 can be activated only when both the fume sensor 208 and heat sensor 210 generate sensing signals, respectively.

For the fume sensor 208 serving to sense noxious gases

and fumes, an analog opto-electric fume sensor may be used. This analog opto-electric fume sensor maintains a monitoring state in order to continuously measure a variation in a factor, to be sensed, depending on a variation in environments (contamination, lapse of time, temperature, humidity, etc.). When the analog opto-electric fume sensor is to be repaired, it may also operate to display this information on an analog control panel. Since a plurality of sensors may be practically installed at different locations, respectively, the location of a sensor to be repaired may be displayed on the analog control panel. For another example of the fume sensor 208, there is an analog ionizing fume sensor. On the other hand, the heat sensor 210 senses a predetermined temperature relatively lower than the melting temperature of the solder included in the heat sensitive fuse 66, that is, about 72°C ± 2°C, for example, a temperature ranging from 50°C to 70°C (preferably, 60°C to 70°C). The heat sensor 210 may be a thermistor such as an analog heat sensor, a current-outputting IC temperature sensor, or a voltage-outputting IC temperature sensor. In order to achieve a rapid sensing operation, the analog heat sensor may use a double thermistor sensing circuit.

The fume sensor 208 and heat sensor 210 are provided with variable resistors, respectively. Accordingly, the critical sensing values of the fume sensor 208 and heat sensor 210 for sensing fumes and temperature can be adjusted by the

associated manufacturers, respectively. That is, the manufacturers can adjust the sensitivities of the fume sensor 208 and heat sensor 210 within predetermined ranges, respectively. For example, the temperature range to be sensed by the heat sensor 210 is 50°C to 70°C.

When at least one of the fume sensor 208 and heat sensor 210 generates a sensing signal in accordance with its sensing operation, the relay 212 is activated in accordance with the generated sensing signal, so that the operating voltage, which may be the battery voltage or the rectified operating voltage, is applied to the fuse heater 112 of the heat sensitive fuse 66 via the relay 212. The operating voltage is also applied to the alarm device 214 and alarm lamp 216. In FIG. 7, the reference character "R" designates a relay driver of the relay 212, and the reference characters "Ra1" and "Ra2" designate relay switches of the relay 212, respectively. When the fuse heater 112 operates in accordance with the voltage applied thereto, it generates heat, thereby fusing the heat sensitive fuse 66. Simultaneously, the alarm device 214 and alarm lamp 216 operate. The alarm device 214 generates a fire alarm such as bells while displaying guidance to shelter. In order to enable occupants in a room to view a light emitted from the alarm lamp 216 even in a state in which the room is clouded with fumes, a flash lamp adapted to generate a flash is preferably used for the alarm lamp 216. Thus, it is possible to allow occupants to rapidly take shelter along a guide line

such as emergency stairs in accordance with guidance by the alarm lamp 216 and alarm device 214.

The elements included in the electrical circuit of the door closer assembly shown in FIG. 7 may be mounted to the upper end of a doorframe 18 in a state of being received in a small box 300, as shown in FIGS. 8A and 8B. As shown in a plan view of FIG. 8B, the small box 330 contains the fume sensor 208, heat sensor 201, battery 206, and a printed circuit board (PCB) 310, on which electrical circuit elements are mounted. The reset switch 207 and alarm device 214 are also installed on the small box 330 such that they are forwardly directed. A connector C3 is mounted to a right surface of the small box 330 in order to externally attach the alarm lamp 216 to the small box 330. Mounted to a rear surface of the small box 330 are a connector C1, to which the commercial AC voltage 200 is to be inputted, and a connector C2 adapted to supply the operating voltage to the fuse heater 112 included in the heat sensitive fuse 66 of the door latching device.

FIG. 9 is a flow chart illustrating a method for releasing the door latching state of the door closer assembly having the circuit configuration shown in FIG. 7.

In accordance with the method illustrated in FIG. 9, noxious gases or fumes generated when a fire breaks out and/or heat generated due to the fire are sensed by the fume sensor 208 and/or the heat sensor 210 at an initial stage of the fire

(Step S400 and/or Step S402 in FIG. 9). In response to the sensed result, the relay 212 is activated (Step S404), so that an operating voltage, which may be a rectified operating voltage or a battery voltage, is applied to the fuse heater 122 of the door latching device 86 via the activated relay 212. Accordingly, the fuse heater 122 generates heat (Step S406), thereby fusing the heat sensitive fuse 66 (Step S410). As a result, the door latching state of the door latching device is released (Step S412). When the heat sensitive fuse 66 is fused, the operating voltage supplied to the fuse heater 112 is automatically cut off.

The operating voltage is also applied to the alarm device 214 and alarm lamp 216 via the relay 212. Accordingly, the alarm device 214 and alarm lamp 216 turn on (Step S408). If the user depresses the reset switch 207 in this state, the supply of the operating voltage is then cut off by the reset switch 207, so that the alarm device 214 and alarm lamp 216 turn off (Step S416).

In accordance with an embodiment of the present invention illustrated in FIG. 9, when a fire breaks out, a primary control operation is first carried out by sensing fumes (primary fume sensing operation) (such fumes may be most rapidly spread), thereby generating a fume sensing signal, in order to automatically close the door. Thereafter, a secondary control operation is carried out by sensing heat at an initial stage of the fire, thereby generating a heat

sensing signal (secondary heat sensing operation). That is, a Even when such primary and secondary control operations based on sensing of fumes and heat are erroneously carried out, a third control operation is subsequently carried out to automatically close the door. That is, when the ambient temperature around the door latching device increases as the fire proceeds, the heat sensitive fuse of the door latching device is naturally fused (third heat sensing operation), so that the door is automatically closed. In accordance with the illustrated embodiment of the present invention, an alarm is generated from the alarm device 214. Also, the alarm lamp 216 emits light for visually alerting occupants of the fire while providing guidance to shelter. Accordingly, it is possible to prevent a loss of lives caused by noxious gases and fumes generated due to the fire, while preventing persons from being killed in the fire due to the fact that they cannot find an emergency exit. By virtue of the alarm device 214 and alarm lamp 216, persons can be guided to the fireproofing door, at which the door closer assembly is installed. After reaching the fireproofing door, the persons can open the fireproofing door by simply pushing the door, and exit through the opened fireproofing door and then along emergency stairs. The opened fireproofing door is subsequently automatically closed by the door closer. Thus, the fumes and flames of the fire are again shielded by the closed fireproofing door. The above described embodiment of the present invention can be more efficiently

applied to large department stores and buildings exhibiting a high density of mobile population.

Meanwhile, FIGS. 10A and 10B illustrate examples of the door operating apparatus for prevention of the spread of a fire, one of which uses an automatic door closing device and a door latching device similar to the door closer 2 and door latching device 86 of the door closer assembly described in conjunction with FIGS. 1 to 9, while the other example using an automatic door closing device and a door latching device different from those of the door closer assembly described in conjunction with FIGS. 1 to 9.

FIG. 10A illustrates a configuration in which an automatic door closing device corresponding to the door closer 2 and a door latching device corresponding to the door latching device 86 adapted to latch a door at a certain opening angle and to release the latched state of the door are operatively connected to each other while being arranged adjacent to each other. On the other hand, FIG. 10B illustrates a configuration in which an automatic door closing device corresponding to the door closer 2 and a door latching device corresponding to the door latching device 86a adapted to latch a door at a certain opening angle and to release the latched state of the door are separate from each other.

In either case of FIG. 10A or FIG. 10B, its automatic door closing device, that is, the door closer 2, is mounted to a door 78 for prevention of the spread of a fire, in order to

perform a function for automatically closing the door 78. Although the automatic door closing device in either case of FIG. 10A or FIG. 10B is implemented by the door closer 2, it may be implemented by an auto hinge or floor hinge. Also, the door latching device, which is designated by reference numeral 86 or 86a in FIG. 10A or 10B, is installed at the door 78 in order to latch the door 78 at a certain opening angle in a normal state to provide convenience to users, while releasing the condition of the door 78 latched in an opened state, if necessary.

Now, the door latching devices 86 and 86a will be described in more detail. In the case of FIG. 10A, the door latching device 86 is operatively connected to the door closer 2 while being arranged adjacent to the door closer 2. This door latching device 86 includes a heat sensitive fuse adapted to be naturally (mechanically) fused when the ambient temperature around the door latching device 86 increases to about 72°C ± 2°C as a fire breaks out. In addition to the heat sensitive fuse, the door latching device 86 of FIG. 10A may be provided with a solenoid-driven latch or a motor-driven latch. In the case of FIG. 10B, the door latching device 86a is installed, separately from the door closer 2. That is, the door latching device 86a includes a door release mounted in the interior of the door 78. This door release includes a solenoid-driven latch, and a heat sensitive fuse adapted to be naturally (mechanically) fused when the ambient temperature

around the door latching device 86 increases to about 72°C ± 2°C as a fire breaks out. The door latching device 86a also includes a holder 7 mounted to a wall arranged at one side of the door 78, and adapted to hold the latch when the door is opened.

When the ambient temperature around the door latching device 86 or 86a of FIG. 10A or 10B gradually increases due to a fire, and reaches a temperature of about 72°C ± 2°C, the heat sensitive fuse included in the door latching device 86 or 86a is naturally (mechanically) fused. Accordingly, the door latching device 86 or 86a releases its state of latching the door 78. As a result, the door 78 maintained in an opened state is automatically closed by the automatic door closing device, that is, the door closer 2.

FIGS. 11 and 12 are circuit diagrams each illustrating a control circuit of the door operating apparatus for prevention of the spread of a fire which is capable of sensing a fire at an initial state of the fire while ensuring a reliable operation for detecting a fire (minimizing erroneous fire detection). FIG. 11 illustrates the case in which the control circuit is applied to the door latching device 86 of the door closer assembly shown in FIGS. 1 to 6, whereas FIG. 12 illustrates the case in which the control unit is applied to a door latching device configured to carry out a latching operation, for example, the door latching device 86a.

The control circuits of FIGS. 11 and 12 operate not only

to prevent the spread of a fire at an initial stage of the fire, but also to minimize the spread of noxious gases and fumes generated at the initial stage of the fire. The configurations of FIGS. 11 and 12 are different from each other in that the door latching devices 86 and 86a are different from each other. The door latching device 86 used in the case of FIG. 11 has the same configuration as that of FIGS. 1 to 6. That is, the door latching device 86 includes a heat sensitive fuse 66 adapted to be naturally fused when the ambient temperature therearound reaches about 72°C ± 2°C, and a fuse heater 112 adapted to forcibly fuse the heat sensitive fuse 66. On the other hand, the door latching device 86a used in the case of FIG. 12 has the same configuration as that of FIG. 10B. That is, the door latching device 86a includes a solenoid-driven latch 534, and a heat sensitive fuse 66a adapted to be naturally fused when the ambient temperature therearound reaches about 72°C ± 2°C.

The control circuits of FIGS. 11 and 12 have a circuit configuration capable of minimizing erroneous fire detection, thereby ensuring a reliable operation for detecting a fire, as compared to the control circuit of FIG. 7. That is, the control circuits of FIGS. 11 and 12 are characterized by the circuit configuration for a primary control operation (based on a primary fume sensing operation), the circuit configuration for a secondary control operation (based on a secondary heat sensing operation), and the configuration of

the heat sensitive fuse 66 or 66a for a third control operation. In accordance with such configurations of the control circuit of FIG. 11 or 12, sensing of fumes is primarily carried out by a fume sensor. A heat sensor operates secondarily. However, the heat sensor does not operate unless the sensing of fumes has been carried out. Accordingly, the actual operation coping with the fire (release of the latched door) is carried out, based on the heat sensing operation of the heat sensor. Since the door latching device 86 or 86a includes the heat sensitive fuse 66 or 66a, the release of the latched door is also carried out through natural fusing of the heat sensitive fuse 66 or 66a occurring when the ambient temperature around the heat sensitive fuse 66 or 66a reaches about 72°C ± 2°C (third control operation).

Referring to FIGS. 11 or 12, the control circuit includes a fume sensor 520 and a heat sensor 522 for sensing the spread of noxious gases and fumes caused by a fire, and the flames of the fire, respectively. In either case of FIG. 11 or FIG. 12, only one fume sensor 520 and only one heat sensor 522 are used. If necessary, an additional fume or heat sensor may be connected to the associated fume or heat sensor 520 or 522 in parallel. Where such an additional sensor is connected to the fume or heat sensor 520 or 522 in parallel, they have the hybrid form of a fume sensor and a heat sensor. The heat sensor 522 of FIG. 11 or 12 may be replaced by a fume

sensor to implement a double fume sensor configuration including first and second fume sensors 520 and 522. Also, the fume sensor 520 of FIG. 11 or 12 may be replaced by a heat sensor to implement a double heat sensor configuration including first and second heat sensors 520 and 522.

The control operations based on sensing operations of the fume sensor 520 and heat sensor 522 in the cases of FIGS. 11 and 12 will be described with reference to FIG. 13 hereinafter. Also, the control operations based on sensing operations of the substitutive configuration using the first and second fume sensors 520 and 522 in the cases of FIGS. 11 and 12 will be described with reference to FIG. 14 hereinafter. The control operations based on sensing operations of the substitutive configuration using the first and second heat sensors 520 and 522 in the cases of FIGS. 11 and 12 will also be described with reference to FIG. 15 hereinafter.

In either case of FIG. 11 or FIG. 12, the fume sensor 520 is connected, at one end thereof, to a reset switch 518 in series while being connected, at the other end thereof, to a relay driver R1 included in a first relay 524. Where it is necessary to use an additional fume sensor in order to increase the reliability of a fume sensing operation, the additional fume sensor should be connected to the fume sensor 520 in parallel. A first alarm device 528 is connected to a node between the fume sensor 520 and the relay driver R1 of

the first relay 524 via a switch Ra1 included in the first relay 524. The heat sensor 522 is also connected to the node between the fume sensor 520 and the relay driver R1 of the first relay 524 via a switch Ra2 included in the first relay 524. That is, the heat sensor is connected, at one end thereof, to the switch Ra2 of the first relay 524. The other end of the heat sensor is connected to a relay driver Re included in a second relay 526. Where it is necessary to use an additional heat sensor in order to increase the reliability of a heat sensing operation, the additional heat sensor should be connected to the heat sensor 522 in parallel. To a node between the heat sensor 522 and the relay driver R2 of the second relay 526, switches Rb1 and Rb2 included in the second relay 526 are connected in parallel. A second alarm device 529 and an alarm lamp 530 are connected in parallel to the first switch Rb1 of the second relay 526. To the second switch Rb2 of the second relay 526, the door latching device 86 or 86a is connected.

The door latching device 86a shown in FIG. 12 includes the solenoid-driven latch 534, and the heat-sensitive fuse 66a, as described above. Typically, this door latching device 86a may be of the type shown in FIG. 10B. In the door latching device 86a of FIG. 12, the solenoid-driven latch 534 carries out an unlatching operation in accordance with an operating voltage supplied thereto via the second switch Rb2 of the second relay 526. In accordance with the unlatching

operation of the solenoid-drive latch 534, the door is released from the holder 7 mounted to the wall 6. Meanwhile, the heat sensitive fuse 66a is naturally (mechanically) fused when the ambient temperature therearound reaches a temperature, at which the latched state of the door is automatically released, that is, about 72°C ± 2°C, due to a fire, so that the solenoid-driven latch 534 is unlatched, thereby releasing the latched state of the door.

On the other hand, the door latching device 86 shown in FIG. 11 includes the heat sensitive fuse 66, and the fuse heater 112, as described above. Typically, this door latching device 86 may be of the type shown in FIG. 10A. In the door latching device 86 of FIG. 11, the heat sensitive fuse 66a is naturally (mechanically) fused when the ambient temperature therearound reaches a temperature, at which the latched state of the door is automatically released, that is, about 72°C ± 2°C, due to a fire, thereby releasing the latched state of the door. The fuse heater 112 heats up in accordance with an operating voltage supplied thereto via the switch Rb2 of the second relay 526, thereby forcibly fusing the heat sensitive fuse 66 before the ambient temperature around the heat sensitive fuse 66 reaches about 72°C ± 2°C. As a result, the door latching state of the door latching device 86 is released.

FIG. 13 is a flow chart illustrating a method for releasing the latched state of the door in the door operating

apparatus for prevention of the spread of a fire according to FIG. 11 or 12. It will be appreciated by those skilled in the art that the procedure of closing the door 78 may be achieved not only by the hardware circuit configuration of FIG. 11 or 12, but also by a program executed using a microprocessor.

Now, the operation of the door operating apparatus for prevention of the spread of a fire will be described with reference to FIGS. 11, 12, and 13.

When fumes caused by a fire are primarily sensed by the fume sensor 518 (Step S1100 in FIG. 13), the first relay 524 is driven (Step S1102 in FIG. 13). As a result, the operating voltage, which may be the battery voltage from the battery 516 or the voltage rectified by the rectifying diode 14, is applied to the heat sensor 522 via the power switch PSW, the fuse FS, and the second switch Ra2 of the first relay 524. The operating voltage is also applied to the first alarm device 528 via the reset switch 518 and the first switch Ra1 of the first relay 524. In accordance with the operating voltage, the heat sensor 522 is activated to perform its heat sensing function. Also, the first alarm device 528 generates a first alarm warning of the generation of the fire (Step S1106 in FIG. 13). The first alarm may be an alarm of a low volume audible only by persons positioned therearound, for example, an alarm of "toot-toot toot-toot". Normally, such a first alarm is generated when the fume sensor 520 senses noxious gases or fumes caused by a fire. However, the first

alarm may be generated even when the fume sensor 520 erroneously senses dust or cigarette smoke as fumes caused by a fire.

It should be noted that when the fume sensor 518 senses fumes, it also sends the sensed result to a building manager's room to inform a building manager of the sensed result, thereby allowing the building manager to manage the warning area associated with the fire sensed by the fume sensor 518 in coping with the warning of the fire.

When the building manager or other person positioned around the warning area recognizes the first alarm to be caused by the fact that the fume sensor 520 erroneously operates due to accumulation of dust thereon or senses cigarette smoke, he may simply depress the reset switch 518 (Step S1108 in FIG. 13), thereby stopping the operation of the first alarm device 528 and the operation of the first relay 534 (Step S1110 in FIG. 13). In accordance with such an operation of the building manager or other person, it is possible to prevent the possibility that the heat sensitive fuse 66 is fused due to erroneous fire detection, loss of elements caused by the fusing of the heat sensitive fuse 66, and inconvenience caused by a requirement to replace the fuse with a new one. It is also possible to prevent subsequent generation of an alarm of a high volume (corresponding to a second alarm generated from the second alarm device 529) informing of generation of a fire, such as a siren, thereby

preventing persons from being startled by the sound of the siren, while providing reliability to the building manager or other user who may be discontented with frequent erroneous operations. If the first alarm is determined to be caused by an erroneous operation of the fume sensor 520, the building manager then performs a subsequent management by, for example, cleaning the fume sensor 520 or externally venting smoke existing around the fume sensor 520.

When the ambient temperature around the heat sensor 522 reaches a predetermined temperature of, for example, 50°C to 70°C (preferably, 60°C to 70°C), as it increases due to a real fire, the heat sensor 522, which is in an active state, senses the predetermined temperature (Step S1112 in FIG. 13). That is, the heat sensor 522 carries out a secondary heat sensing operation, thereby generating a heat sensing signal. The temperature predetermined within the temperature range from 50°C to 70°C is relatively lower than the natural (mechanical) fusing temperature of the heat sensitive fuses 66 and 66a respectively included in the door latching devices 86 and 86a of FIGS. 11 and 12. That is, the predetermined temperature corresponds to the ambient temperature around the heat sensor 522 at an initial stage of the fire.

In accordance with the secondary heat sensing operation by the heat sensor 522, the second relay 526 is driven (Step S1114 in FIG. 13). As a result, an operating voltage is applied to the door latching device 86 via the second switch

Rb2 of the second relay 526, so that the door latching device 86 performs an operation for releasing its door latching state (Step S1117 in FIG. 13). When the door latching device 86 releases its door latching state, the door 78 is automatically closed by the automatic door closing device, that is, the door closer 2 in the case of FIG. 10A or 10B (Step S1122 in FIG. 13).

This operation will be described in more detail with reference to FIGS. 11 and 12. When an operating voltage is applied to the fuse heater 112 via the second switch Rb2 of the second relay 526 in the case of FIG. 11, it heats the heat sensitive fuse 66, thereby forcibly fusing the heat sensitive fuse 66. As a result, the door latching state of the door latching device 86 is released. On the other hand, when an operating voltage is applied to the solenoid-driven latch 534 of the door latching device 86a via the second switch Rb2 of the second relay 526 in the case of FIG. 12, the solenoid-driven latch 534 performs an unlatching operation, thereby releasing the door 78 latched to the holder 7 on the wall 6 shown in FIG. 10B.

When the door latching state of the door latching device 86 is released, the door 78 is automatically closed by the automatic door closing device such as the auto hinge or door closer 2. Accordingly, there is no further spread of the fire.

Referring to FIG. 13 again, when the secondary heat

sensing operation by the heat sensor 522 is carried out (Step S1112 in FIG. 13), the operating voltage is also applied to the alarm lamp 530 and the second alarm lamp 529 connected to the alarm lamp 530 in parallel via the first switch Rb1 of the second relay 526. As result, the second alarm lamp 529 outputs a second alarm informing of generation of a real fire. Simultaneously, the alarm lamp 530 emits light for visually alerting of the fire while providing guidance to shelter (Step S1118 in FIG. 13). The second alarm raised from the second alarm device 528 may be an alarm siren which is mainly used in fire trucks. In order to enable persons in a room to view the light emitted from the alarm lamp 216 even in a state in which the room is clouded with fumes, a flash is preferably used for the alarm lamp 216. The provision of the second alarm device 529 and/or the alarm lamp 530 is optional. In accordance with the provision of the second lamp device 529 and/or the alarm lamp 530, persons can rapidly take shelter along a guide line such as emergency stairs in accordance with guidance by the alarm lamp 530 and second alarm device 529 even under the condition in which the supply of electric power has been cut off due to the fire, and noxious gases and fumes have spread.

Meanwhile, in accordance with the embodiment of the present invention illustrated in FIG. 11 or 12, the door latching device 86 or 86a includes the heat sensitive fuse 66 or 66a. Accordingly, even when the control circuit does not perform primary and secondary control operations based on fume

and heat sensing operations, the heat sensitive fuse 66 or 66a is naturally (mechanically) fused when the ambient temperature around the heat sensitive fuse 66 or 66a reaches about 72°C ± 2°C as it increases due to the fire (Step S1120 in FIG. 13). As a result, the door latching state of the door latching device 86 is released, so that the unlatched door 78 is automatically closed by the automatic door closing device such as the auto hinge or door closer 2. Accordingly, there is no further spread of the fire.

In accordance with the above described embodiments of the present invention, when a fire breaks out, it is primarily warned, based on a fume sensing operation of the fume sensor (fumes may be most rapidly spread). In accordance with the fume sensing operation, the heat sensor is also activated to enable sensing of heat. Subsequently, a secondary control operation is carried out, based on an operation of the heat sensor sensing heat at an initial stage of the fire, in order to control the door to be automatically closed. Since the heat sensor is normally in an inactive state until the fume sensor senses fumes, in accordance with the above described control, there is also an economical advantage in terms of use of electric power. In accordance with the above described embodiments of the present invention, it is possible to ensure a reliable door closing operation for prevention of the spread of a fire because even if there are errors in the primary fume sensing operation and secondary heat sensing operation (or

primary and secondary fume sensing operations or primary and secondary heat sensing operations), the heat sensitive fuse is naturally (mechanically) fused in accordance with an increase in the ambient temperature caused by the fire (third sensing operation), thereby causing the door to be automatically closed. In accordance with the above described embodiments of the present invention, an alarm is generated from the alarm device. Also, the alarm lamp emits light for visually alerting of the fire while providing guidance to shelter. Accordingly, it is possible to prevent a loss of lives caused by noxious gases and fumes generated due to the fire, while preventing persons from being killed in the fire due to the fact that they cannot find an emergency exit. By virtue of the alarm device and alarm lamp, persons can be guided to the fireproofing door, at which the door closer assembly is installed. After reaching the fireproofing door, the persons can open the fireproofing door by simply pushing the door, and exit through the opened fireproofing door and then along emergency stairs. The opened fireproofing door is subsequently automatically closed by the auto hinge or door closer. The above described embodiments of the present invention can be more efficiently applied to large department stores and buildings exhibiting a high density of mobile population.

FIG. 14 is a flow chart illustrating an operation of the door operating apparatus in which the heat sensor 522 of FIG.

11 or 12 is replaced by a fume sensor to implement a double fume sensor configuration including first and second fume sensors 520 and 522. FIG. 15 is a flow chart illustrating an operation of the door operating apparatus in which the fume sensor 520 of FIG. 11 or 12 is replaced by a heat sensor to implement a double fume sensor configuration including first and second heat sensors 520 and 522.

The control procedure carried out in the case, in which the heat sensor 522 of FIG. 11 or 12 is replaced by a fume sensor to implement a double fume sensor configuration including first and second fume sensors 520 and 522, is substantially the same as that of FIG. 13, except that the primary and secondary control operations are carried out based on a primary fume sensing operation by the first fume sensor 520 and a secondary fume sensing operation by the second fume sensor 522. It is desirable that first and second predetermined fume concentrations respectively set for the first and second fume sensors 520 and 522 to sense fumes are different from each other. Preferably, the second predetermined fume concentration of the second fume sensor 522 is higher than the first predetermined fume concentration of the first fume sensor 520. Conventional fume sensors are classified into an accumulation type and a non-accumulation type. Also, such conventional fume sensors are classified into three kinds in terms of sensitivity. Accordingly, the first and second fume sensors 520 and 522 respectively having

the first and second predetermined fume concentrations for sensing of fumes can be implemented using various conventional fume sensors.

The control procedure carried out in the case, in which the fume sensor 520 of FIG. 11 or 12 is replaced by a heat sensor to implement a double heat sensor configuration including first and second heat sensors 520 and 522, is substantially the same as that of FIG. 13, except that the primary and secondary control operations are carried out based on a primary heat sensing operation by the first heat sensor 520 and a secondary heat sensing operation by the second heat sensor 522. It is desirable that first and second predetermined temperatures respectively set for the first and second heat sensors 520 and 522 to sense heat are different from each other within a temperature range from 50°C to 70°C. Preferably, the second predetermined temperature of the second fume sensor 522 is higher than the first predetermined temperature of the first heat sensor 520. For example, the first predetermined temperature is 50°C, whereas the second predetermined temperature is 60°C.

Although the door closing operation is carried out in accordance with two sensing operations based on fumes or heat in the above described embodiments of the present invention, it may be carried out in accordance with N sensing operations (N is a natural number). For example, N sensors, which are fume sensors, heat sensors, or a combination thereof, may be

used to sequentially perform N sensing operations. In this case, when a lower-order one of the sensors senses heat or fumes, it generates a message warning of a fire, while simultaneously activating a next-order one of the sensors. Such an operation is repeated until all sensors are activated. In this case, the door latching device is controlled to release its door latching state when the last sensor, that is, the highest-order sensor, senses fumes or heat, thereby causing the door to be automatically closed. Such a fire verification through N sensing operations provides a high reliability in detecting a fire.

As apparent from the above description, in accordance with the present invention, it is possible to reliably sense noxious gases or fumes caused by a fire, or the flames of the fire at an initial stage of the fire, thereby immediately releasing the latched state of a door, and thus, allowing the door to be automatically closed by a door closer, so that the noxious gases or fumes and the flames of the fire are prevented from spreading. In accordance with the present invention, an alarm device is provided to generate an alarm when a fire is sensed. Also, an alarm lamp is also provided to emit light for visually alerting of the fire while providing guidance to shelter, thereby allowing persons to easily find an emergency exit. The present invention also provides an inexpensive door closer assembly having a superior reliability. In accordance with the present invention, it is

also possible to minimize erroneous fire detection through a plurality of sequential fume and/or heat sensing operations, thereby ensuring a high operation reliability while preventing the spread of a fire at an initial stage of the fire, and allowing persons to easily take shelter. It is also possible to rapidly detect a fire and rapidly cope with the spread of the fire, based on a raid determination of the user or manager. There are also advantages in that it is possible to reduce generation of costs, inconvenience, and troublesomeness caused by an erroneous operation thereof caused by an erroneous fire detection thereof.

Although the preferred embodiments of the invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

Industrial Applicability

The present invention is applicable to a fireproofing system. The present invention is also applicable to a fireproofing door operating apparatus or a general door operating apparatus.

Claims:

1. A door operating apparatus for prevention of the spread of a fire, comprising:

a door closer for performing an automatic door closing function;

a fume sensor for sensing fumes caused by a fire, and generating a fume sensing signal when a predetermined fume concentration is sensed;

a heat sensor for sensing an ambient temperature, and generating a temperature sensing signal when the ambient temperature does not reach a first predetermined temperature for automatically releasing a latched state of a door to cope with a fire, but reaches a second predetermined temperature lower than the first predetermined temperature, the second predetermined temperature representing an initial stage of the fire; and

a door latching device operatively connected to the door closer, and adapted to latch the door at an opening position desired by a user, the door latching device releasing the latched state of the door in response to the ambient temperature when the ambient temperature reaches the first predetermined temperature due to the fire, while forcibly releasing the latched state of the door by an operating voltage applied thereto in accordance with at least one of the fume sensing signal from the fume sensor and the temperature

sensing signal from the heat sensor.

2. The door operating apparatus according to claim 1, wherein the first predetermined temperature is about 72°C ± 2°C.

3. The door operating apparatus according to claim 2, wherein the second predetermined temperature ranges from 50°C to 70°C.

4. The door operating apparatus according to claim 3, wherein the door latching device comprises a heat sensitive fuse assembly adapted to provide a function for releasing the latched state of the door, the heat sensitive fuse assembly comprising:

a pair of support pieces hingably coupled to each other at one-side ends thereof while being separably connected at the other-side ends thereof, the support pieces maintaining the latched state of the door at a connected state of the other-side ends thereof while releasing the latched state of the door at a separated state of the other-side ends thereof;

a heat sensitive fuse adapted to connect the other-side ends of the support pieces, the heat sensitive fuse being naturally fused when the ambient temperature reaches the first predetermined temperature, thereby separating the other-side ends of the support pieces; and

a fuse heater adapted to emit heat when the operating voltage is applied thereto in accordance with at least one of the fume sensing signal from the fume sensor and the temperature sensing signal from the heat sensor, thereby forcibly fusing the heat sensitive fuse.

5. The door operating apparatus according to claim 1, further comprising:

an alarm device for raising an alarm informing of the fire when the operating voltage is applied thereto in accordance with at least one of the fume sensing signal from the fume sensor and the temperature sensing signal from the heat sensor.

6. The door operating apparatus according to claim 5, further comprising:

an alarm lamp for emitting light for visually alerting of the fire while providing guidance to shelter, when the operating voltage is applied thereto in accordance with at least one of the fume sensing signal from the fume sensor and the temperature sensing signal from the heat sensor.

7. The door operating apparatus according to claim 4, wherein the heat sensitive fuse comprises upper and lower pieces bonded to each other by a solder; and holders respectively extending from the upper and lower pieces to hold

the fuse heater.

8. The door operating apparatus according to claim 7, wherein the fuse heater comprises:

an outer tube made of a copper material;

a heater coil received in the outer tube, and adapted to generate heat when the operating voltage is applied thereto in accordance with at least one of the fume sensing signal from the fume sensor and the temperature sensing signal from the heat sensor; and

an insulating bobbin adapted to surround the heater coil.

9. The door operating apparatus according to claim 1, further comprising:

an operating voltage supply unit for supplying a selected one of a voltage from an input voltage source and a voltage from a rechargeable battery, as the operating voltage.

10. The door operating apparatus according to claim 9, wherein the operating voltage supply unit comprises:

a transformer adapted to transform a commercial AC voltage into at least one predetermined voltage level;

a rectifier adapted to rectify the voltage transformed by the transformer, thereby supplying a rectified DC voltage as an operating voltage; and

a battery adapted to be charged by the DC voltage, and to supply the charged DC voltage as the operating voltage.

11. The door operating apparatus according to claim 6, further comprising:

at least one switch for stopping operations of the alarm device and alarm lamp.

12. The door operating apparatus according to claim 1, wherein the predetermined fume concentration of the fume sensor and the second predetermined temperature of the temperature sensor are adjustable by associated manufacturers, respectively.

13. A door operating apparatus for prevention of the spread of a fire, comprising:

a door closer for performing an automatic door closing function;

a door latching device operatively connected to the door closer, and adapted to latch the door at an opening position desired by a user, the door latching device releasing the latched state of the door in response to an ambient temperature when the ambient temperature reaches a predetermined temperature due to a fire;

a fume sensor for sensing fumes caused by the fire, and generating a fume sensing signal when a predetermined fume

concentration is sensed; and

a forcible door latching releasing unit for forcibly releasing the door latching state of the door latching device by an operating voltage applied thereto in accordance with the fume sensing signal from the fume sensor.

14. The door operating apparatus according to claim 13, wherein the door latching device comprises a heat sensitive fuse assembly adapted to provide a function for releasing the latched state of the door, the heat sensitive fuse assembly comprising a heat sensitive fuse adapted to be fused by the ambient temperature when the ambient temperature reaches a fusing temperature of the heat sensitive fuse, thereby releasing the latched state of the door.

15. The door operating apparatus according to claim 14, wherein the forcible door latching releasing unit is a fuse heat for forcibly fusing the heat sensitive fuse when the operating voltage is applied thereto in accordance with the fume sensing signal from the fume sensor.

16. The door operating apparatus according to claim 15, wherein the fuse heater comprises:

an outer tube made of a copper material;

a heater coil received in the outer tube, and adapted to generate heat when the operating voltage is applied thereto

via a voltage input line; and

an insulating bobbin adapted to surround the heater coil.

17. A door closer assembly for prevention of the spread of a fire, comprising:

a door closer adapted to perform a function for automatically closing a door, while latching the door at a desired opening position, the door latching device releasing the latched state of the door in response to an ambient temperature when the ambient temperature reaches a first predetermined temperature due to a fire;

a fume sensor for sensing fumes caused by the fire, and generating a fume sensing signal when a predetermined fume concentration is sensed;

a heat sensor for sensing the ambient temperature, and generating a temperature sensing signal when the ambient temperature increasing due to the fire reaches a second predetermined temperature lower than the first predetermined temperature; and

a forcible door latching releasing unit for forcibly releasing the door latching state of the door closer by an operating voltage applied thereto in accordance with at least one of the fume sensing signal from the fume sensor and the temperature sensing signal from the heat sensor.

18. A method for operating a door operating apparatus for prevention of the spread of a fire including a door closer for performing an automatic door closing function, and a door latching device operatively connected to the door closer, and adapted to latch the door at a desired opening position, the door latching device releasing the latched state of the door in accordance with fusing of a heat sensitive fuse, included therein, carried out in response to an ambient temperature when the ambient temperature reaches a first predetermined temperature due to a fire, the method comprising the steps of:

sensing fumes caused by the fire, and generating a fume sensing signal when a predetermined fume concentration is sensed;

sensing the ambient temperature, and generating a temperature sensing signal when the ambient temperature increasing due to the fire reaches a second predetermined temperature lower than the first predetermined temperature; and

receiving an operating voltage in accordance with at least one of the fume sensing signal and the temperature sensing signal, and forcibly fusing the heat sensitive fuse by the received operating voltage, thereby releasing the door latching state of the door latching device.

19. The method according to claim 18, further comprising the steps of:

emitting light for visually alerting of the fire while providing guidance to shelter, and generating an alarm informing of the fire, by the operating voltage received in accordance with the at least one of the fume sensing signal and the temperature sensing signal.

20. The method according to claim 18, wherein the emission of the light for visually alerting of the fire while providing guidance to shelter, and the generation of the alarm informing of the fire are stopped when a user depresses a reset switch.

21. A door operating apparatus for prevention of the spread of a fire comprising an automatic door closing device adapted to perform a function for automatically closing a door, further comprising:

a fume sensor unit for sensing fumes caused by the fire, and generating a fume sensing signal when a predetermined fume concentration is sensed;

a first switch for selectively supplying an operating voltage in accordance with the fume sensing signal from the fume sensor unit;

an alarm device adapted to be driven by the operating voltage applied thereto via the first switch, thereby outputting an alarm warning of the fire;

a heat sensor unit adapted to be activated by the operating voltage applied thereto via the first switch to

sense an ambient temperature, the heat sensor unit generating a temperature sensing signal when the ambient temperature does not reach a first predetermined temperature for naturally releasing a latched state of the door to cope with the fire, but reaches a second predetermined temperature lower than the first predetermined temperature due to the fire, the second predetermined temperature representing an initial stage of the fire;

a second switch for selectively supplying the operating voltage applied thereto via the first switch, in accordance with the temperature sensing signal from the heat sensor unit; and

a door latching releasing unit for latching the door in an opened state while releasing the latched state of the opened door by the operating voltage applied thereto via the second switch, thereby causing the door to be automatically closed, the door latching releasing unit also releasing the latched state of the door when the ambient temperature reaches the first predetermined temperature due to the fire, thereby allowing the door to be automatically closed by the automatic door closing device.

22. The door operating apparatus according to claim 21, wherein the first predetermined temperature is about 72°C ± 2°C, and the second predetermined temperature ranges from 50°C to 70°C.

23. The door operating apparatus according to claim 22, further comprising:

an alarm device connected to the second switch, and adapted to be driven by the operating voltage applied thereto via the second switch, thereby raising an alarm informing of the fire; and

an alarm lamp connected to the alarm device in parallel, and adapted to be driven by the operating voltage applied thereto via the second switch, thereby emitting light for visually alerting of the fire while providing guidance to shelter.

24. The door operating apparatus according to claim 23, wherein the door latching releasing unit comprises:

a solenoid-driven latch adapted to be driven by the operating voltage applied thereto via the second switch, thereby releasing the latched state of the door; and

a heat sensitive fuse adapted to be naturally fused when the ambient temperature reaches the first predetermined temperature for automatically releasing the latched state of the door, due to the fire, thereby mechanically releasing the latched state of the door.

25. The door operating apparatus according to claim 23, wherein the door latching releasing unit comprises:

a heat sensitive fuse adapted to be naturally fused when the ambient temperature reaches the first predetermined temperature for automatically releasing the latched state of the door, due to the fire, thereby mechanically releasing the latched state of the door; and

a fuse heater adapted to generate heat by the operating voltage applied thereto via the second switch, thereby forcibly fusing the heat sensitive fuse.

26. The door operating apparatus according to claim 21, wherein the fume sensor unit comprises one or more fume sensors connected in parallel.

27. The door operating apparatus according to claim 21, wherein the heat sensor unit comprises one or more heat sensors connected in parallel.

28. A method for operating, for prevention of the spread of a fire, a door closer assembly including an automatic door closing device adapted to perform a function for automatically closing a door, a fume sensor adapted to sense fumes, a heat sensor adapted to sense heat, and a door latching device adapted to latch the door in an opened state, and to release the latched state of the opened door, the door latching device including a heat sensitive fuse, the method comprising the steps of:

generating a message warning of a fire when the fume sensor senses fumes, while simultaneously activating the heat sensor;

forcibly fusing the heat sensitive fuse of the door latching device when the heat sensor does not sense a first predetermined temperature, at which the heat sensitive fuse is naturally fused, but senses a second predetermined temperature lower than the first predetermined temperature, thereby releasing the latched state of the door to allow the door to be closed by the automatic door closing device; and

making the door latching device release the latched state of the door when the heat sensitive fuse of the door latching device is naturally fused as an ambient temperature reaches the first predetermined temperature due to a fire, thereby allowing the door to be automatically closed by the automatic door closing device.

29. The method according to claim 28, further comprising the step of:

generating an alarm informing of the fire, and emitting light for visually alerting of the fire while providing guidance to shelter when the heat sensor senses the second predetermined temperature.

30. The method according to claim 28, wherein the message warning of a fire is at least one of an alarm of a volume

considerably lower than an alarm informing of a real fire and an alarm informing a manager of a fire.

31. The method according to claim 29, wherein the first predetermined temperature is about 72°C ± 2°C, and the second predetermined temperature ranges from 50°C to 70°C.

FIG. 1

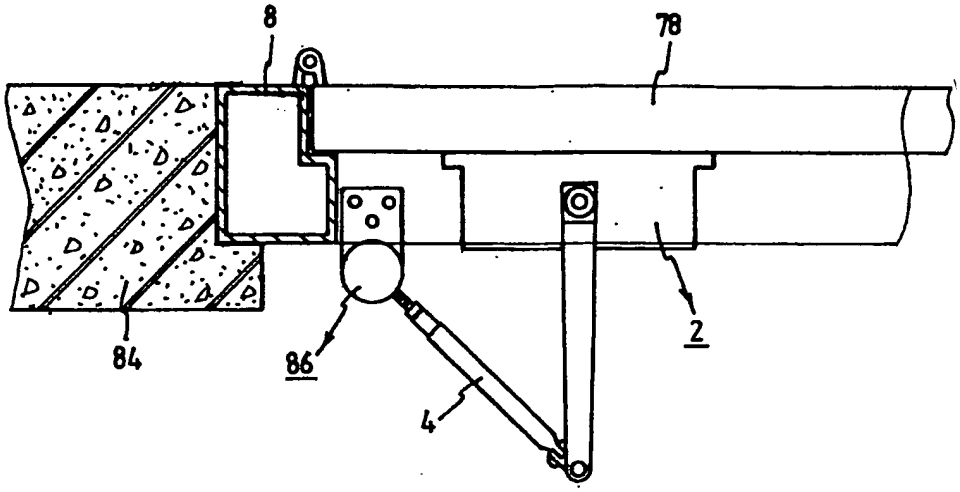


FIG. 2

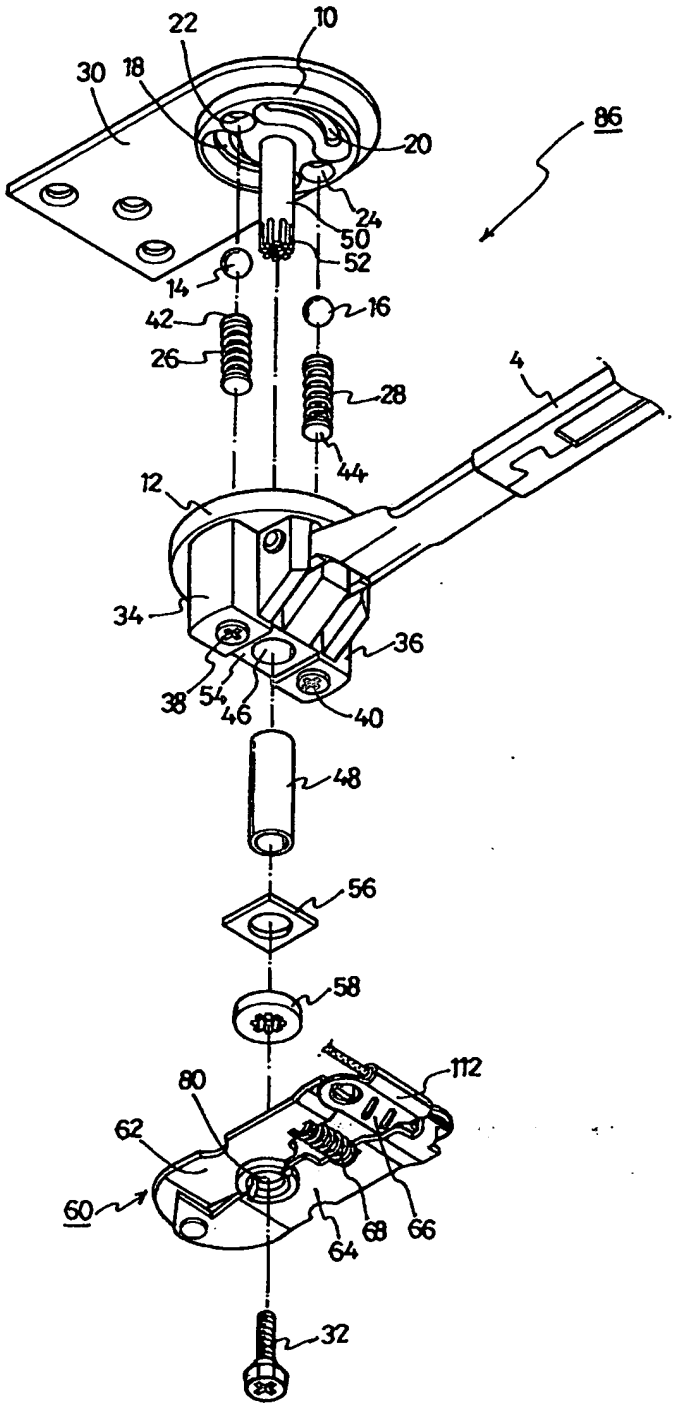

22
10
30
18
20
86
24
50
52
14
16
42
26
28
4
44
12
34
36
38
54
46
40
48
56
58
112
80
62
60
68
66
64
32

FIG. 3

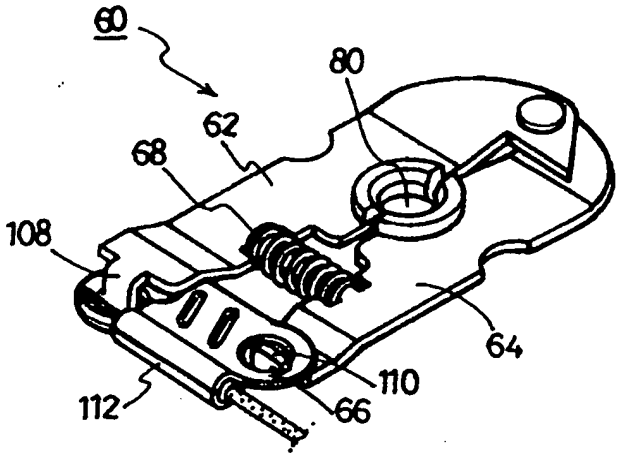


FIG. 4

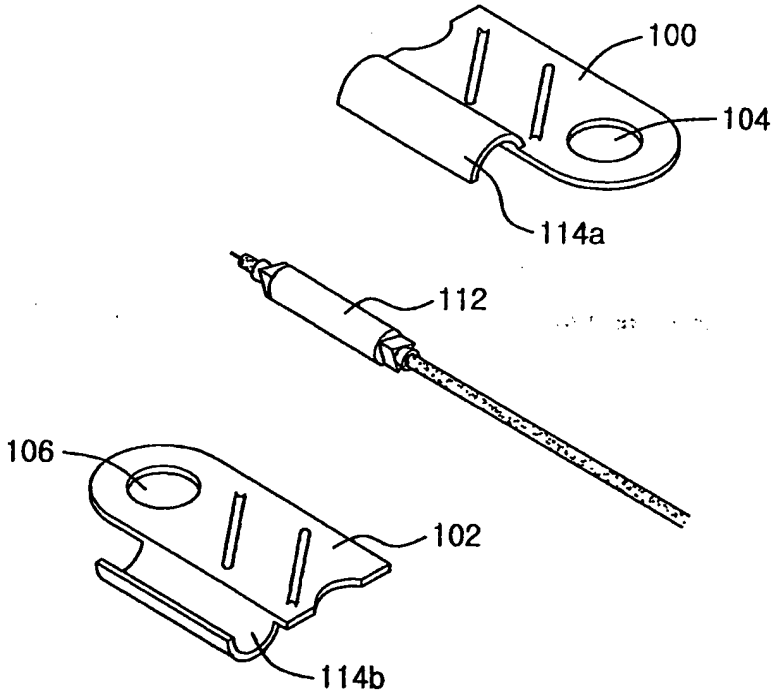


FIG. 5A

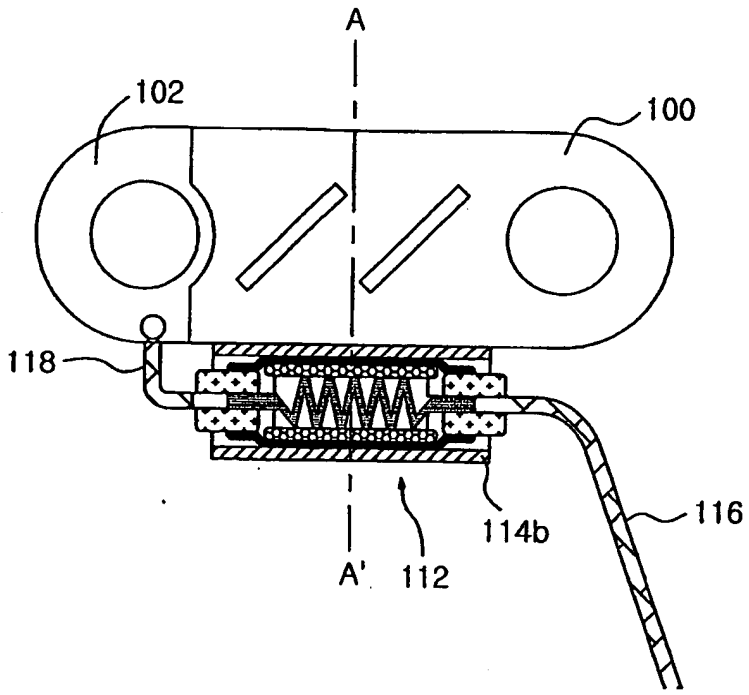


FIG. 5B

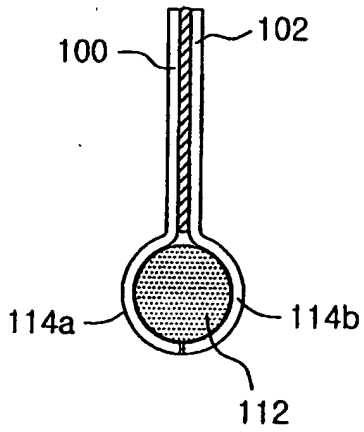


FIG. 6

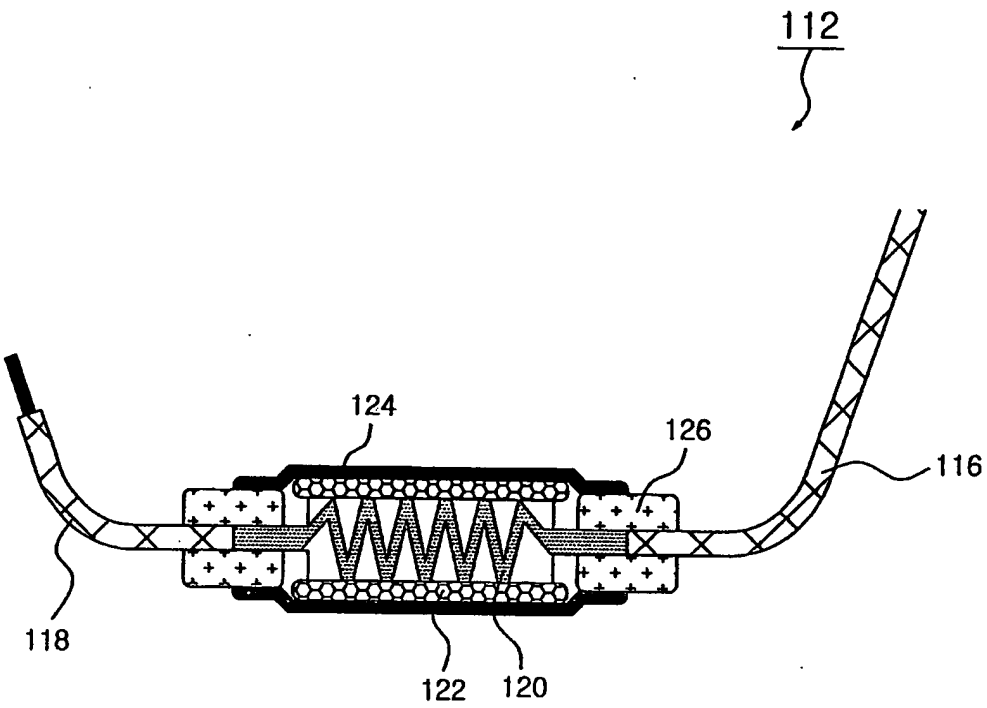


FIG. 7

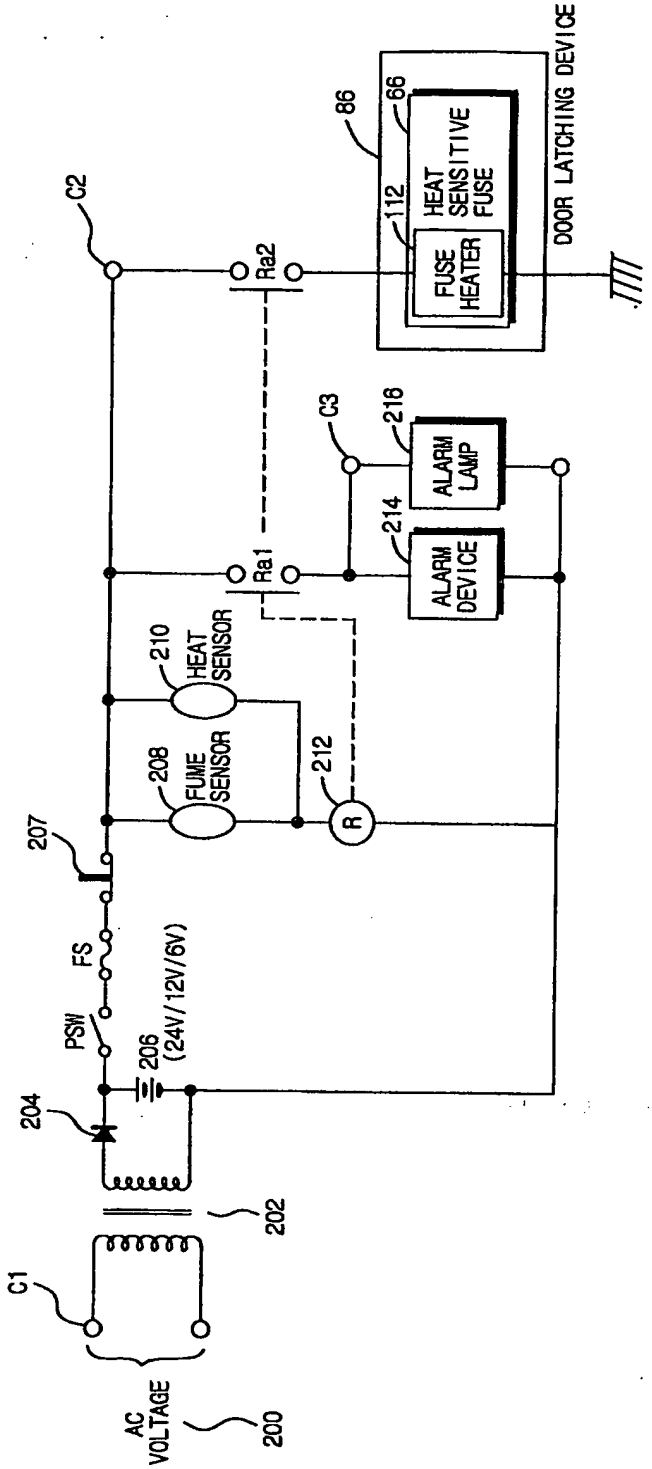

DOOR LATCHING DEVICE
86
66
HEAT SENSITIVE FUSE
112
FUSE HEATER
C2
Ra2
C3
216
ALARM LAMP
214
ALARM DEVICE
Ra1
210
HEAT SENSOR
208
FUME SENSOR
212
R
207
FS
PSW
206
(24V/12V/6V)
204
202
C1
AC VOLTAGE
200

FIG. 8A

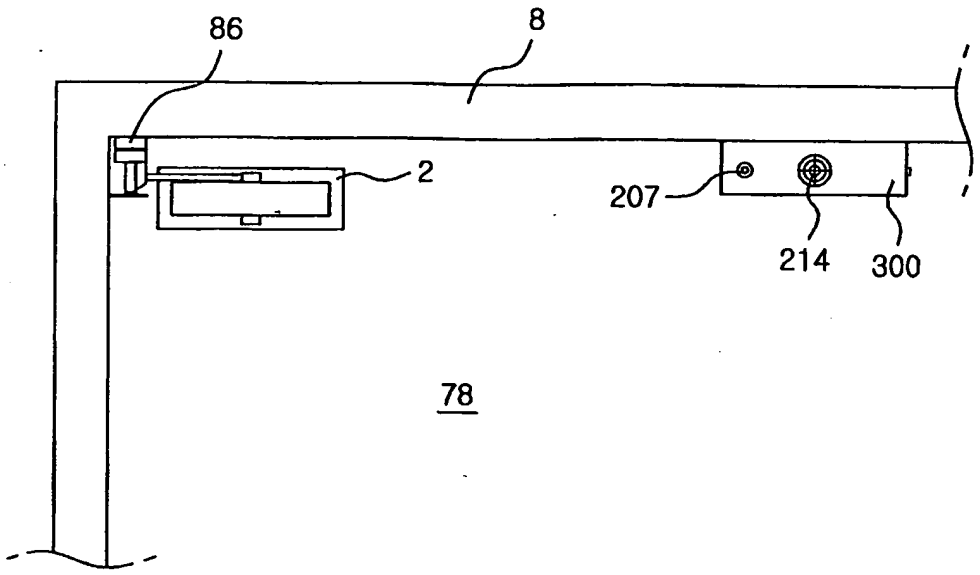

86
8
2
207
214
300
78

FIG. 8B

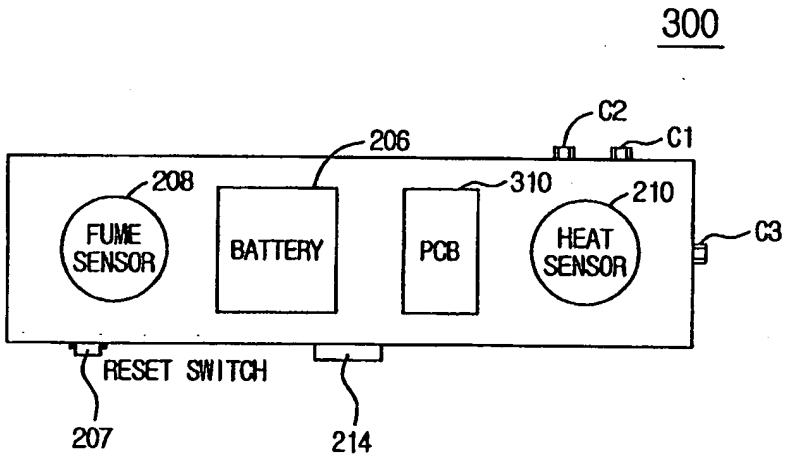

300
C2
C1
206
208
310
210
C3
FUME SENSOR
BATTERY
PCB
HEAT SENSOR
RESET SWITCH
207
214

FIG. 9

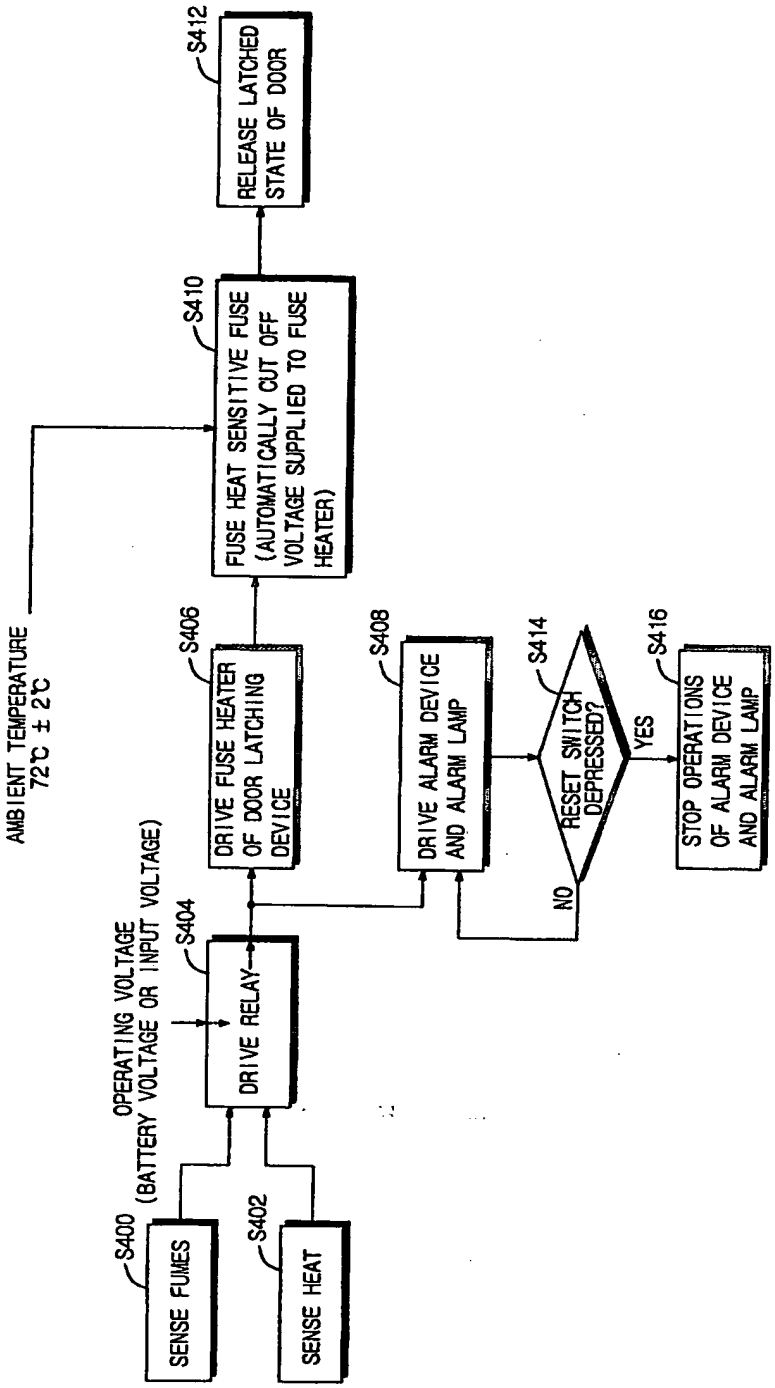

S400
SENSE FUMES
S402
SENSE HEAT
OPERATING VOLTAGE
(BATTERY VOLTAGE OR INPUT VOLTAGE)
S404
DRIVE RELAY
S406
DRIVE FUSE HEATER OF DOOR LATCHING DEVICE
S408
DRIVE ALARM DEVICE AND ALARM LAMP
S410
FUSE HEAT SENSITIVE FUSE (AUTOMATICALLY CUT OFF VOLTAGE SUPPLIED TO FUSE HEATER)
S412
RELEASE LATCHED STATE OF DOOR
AMBIENT TEMPERATURE
72℃ ± 2℃
S414
RESET SWITCH DEPRESSED?
YES
NO
S416
STOP OPERATIONS OF ALARM DEVICE AND ALARM LAMP

FIG. 10A

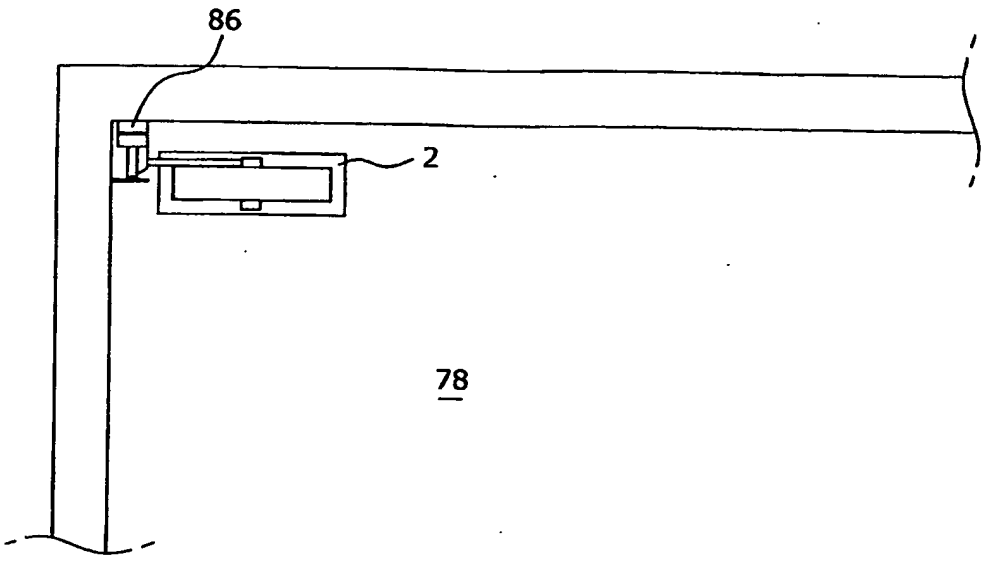


FIG. 10B

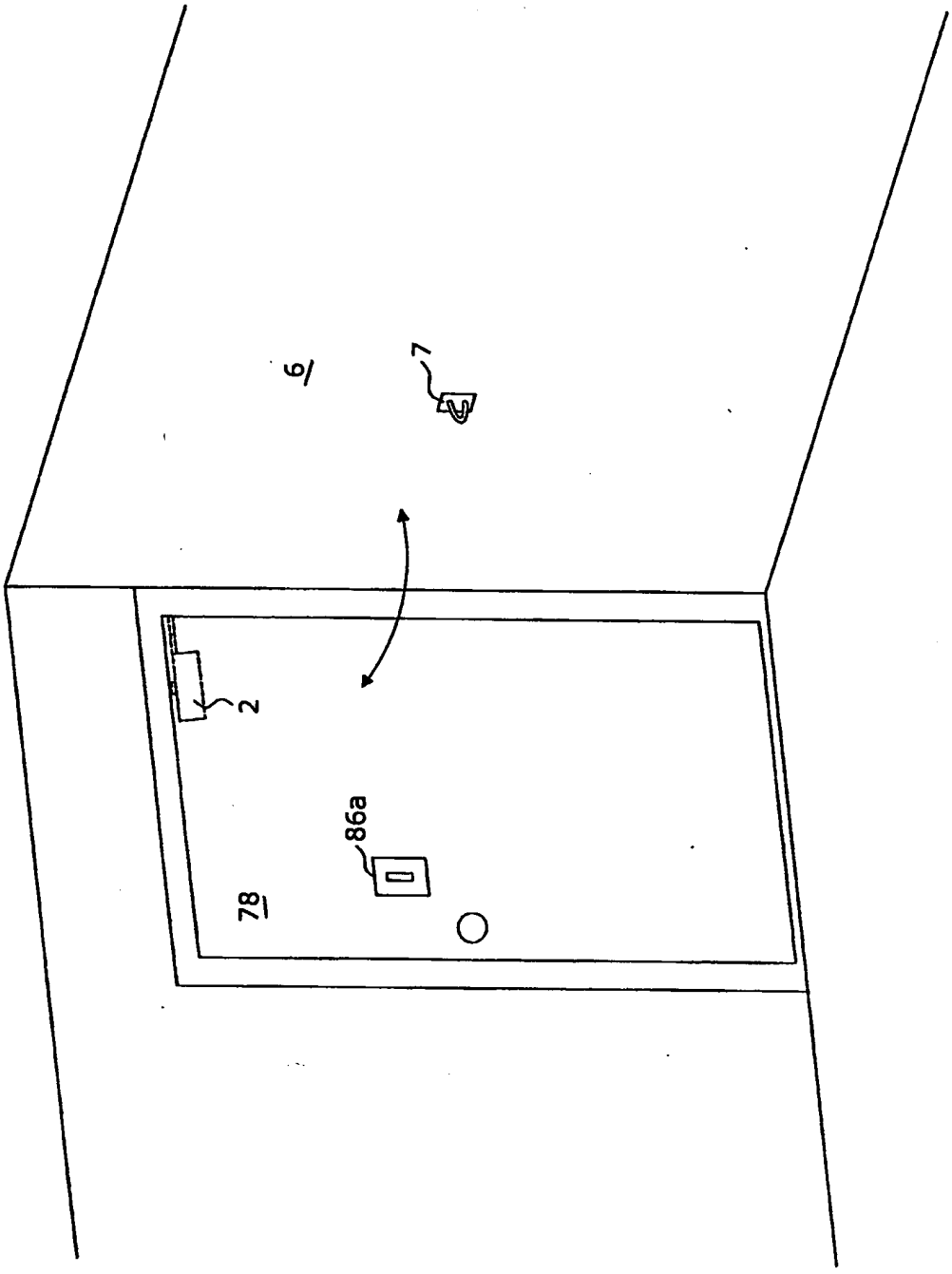


FIG. 11

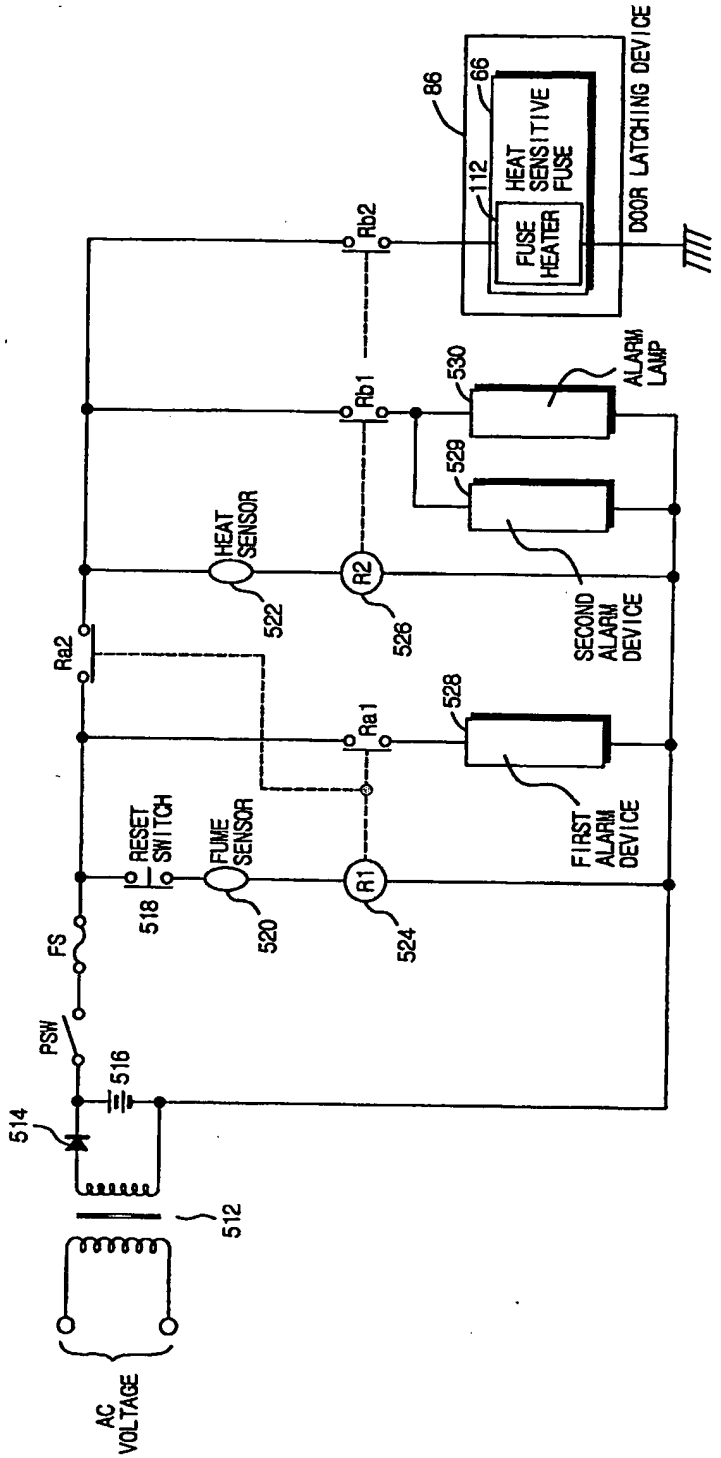

AC VOLTAGE
512
514
516
PSW
FS
518
RESET SWITCH
520
FUME SENSOR
524
R1
526
R2
522
HEAT SENSOR
Ra2
Ra1
Rb1
Rb2
528
FIRST ALARM DEVICE
528
SECOND ALARM DEVICE
530
ALARM LAMP
86
112
66
HEAT SENSITIVE FUSE
FUSE HEATER
DOOR LATCHING DEVICE

FIG. 12

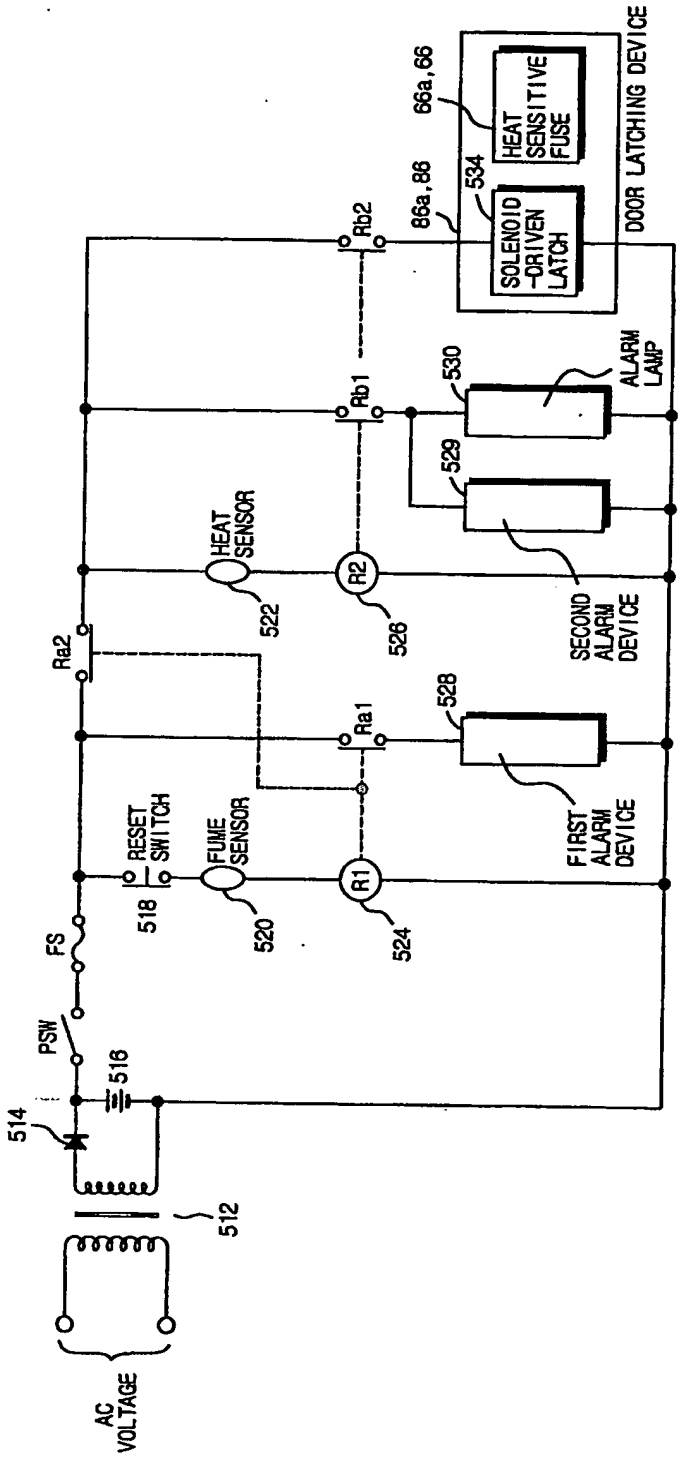

AC VOLTAGE
512
514
516
PSW
FS
518
RESET SWITCH
520
FUME SENSOR
522
HEAT SENSOR
524
526
R1
R2
Ra1
Ra2
Rb1
Rb2
528
FIRST ALARM DEVICE
529
SECOND ALARM DEVICE
530
ALARM LAMP
534
SOLENOID -DRIVEN LATCH
86a,86
66a,66
HEAT SENSITIVE FUSE
DOOR LATCHING DEVICE

FIG. 13

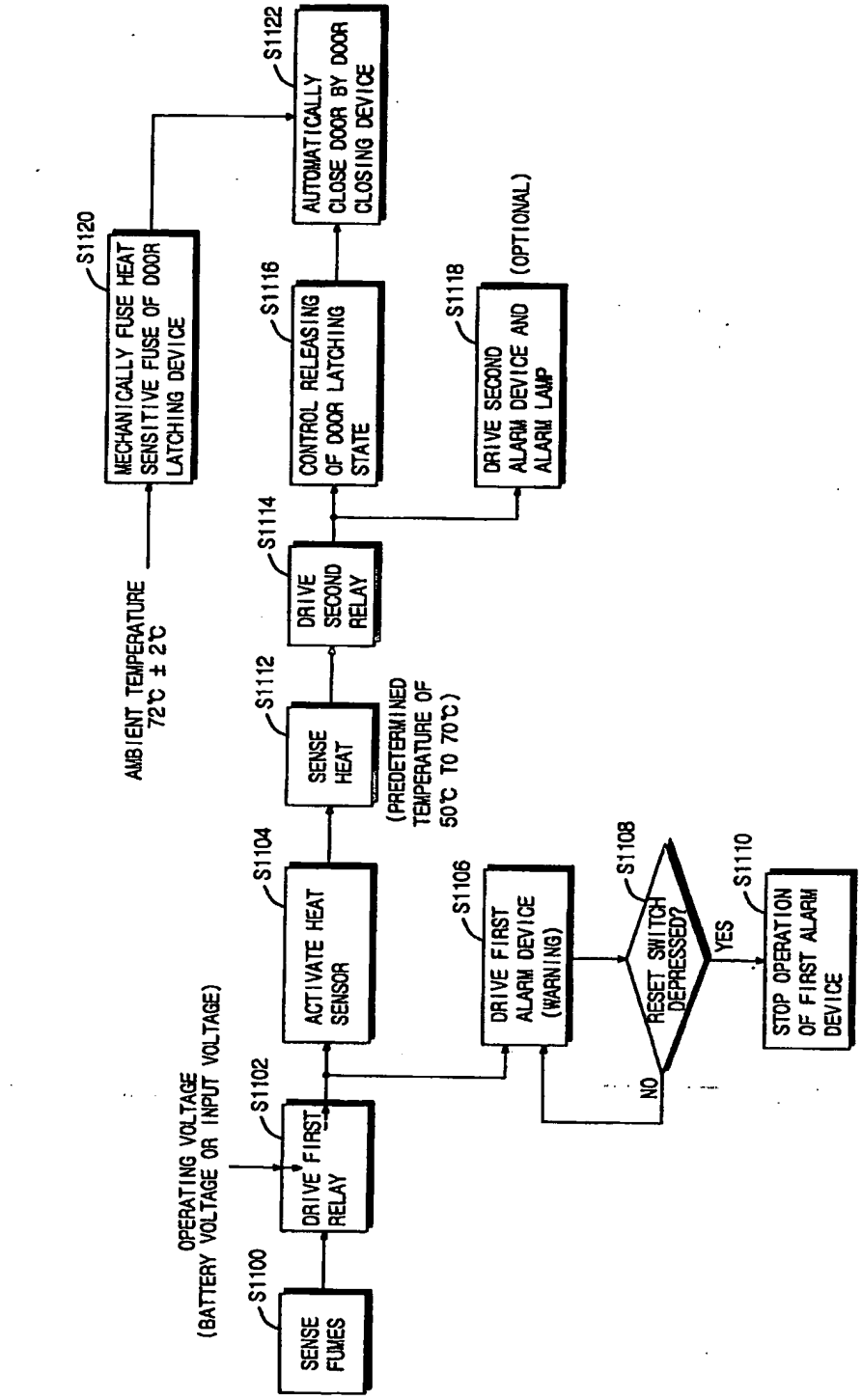

S1100
SENSE FUMES
S1102
DRIVE FIRST RELAY
OPERATING VOLTAGE
(BATTERY VOLTAGE OR INPUT VOLTAGE)
S1104
ACTIVATE HEAT SENSOR
S1106
DRIVE FIRST ALARM DEVICE (WARNING)
S1108
RESET SWITCH DEPRESSED?
YES
NO
S1110
STOP OPERATION OF FIRST ALARM DEVICE
S1112
SENSE HEAT
(PREDETERMINED TEMPERATURE OF 50℃ TO 70℃)
S1114
DRIVE SECOND RELAY
S1116
CONTROL RELEASING OF DOOR LATCHING STATE
S1118
DRIVE SECOND ALARM DEVICE AND ALARM LAMP
(OPTIONAL)
S1120
MECHANICALLY FUSE HEAT SENSITIVE FUSE OF DOOR LATCHING DEVICE
AMBIENT TEMPERATURE 72℃ ± 2℃
S1122
AUTOMATICALLY CLOSE DOOR BY DOOR CLOSING DEVICE

FIG. 14

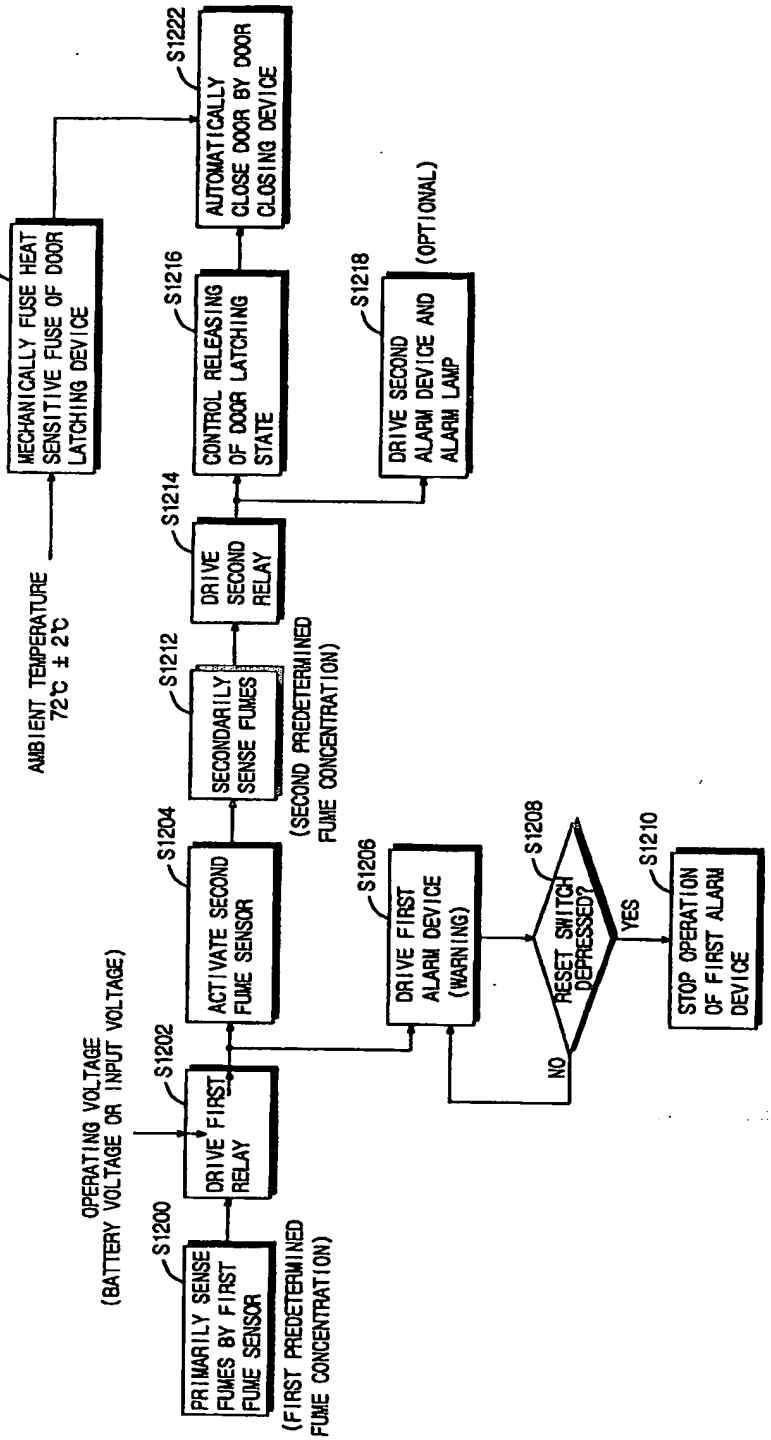
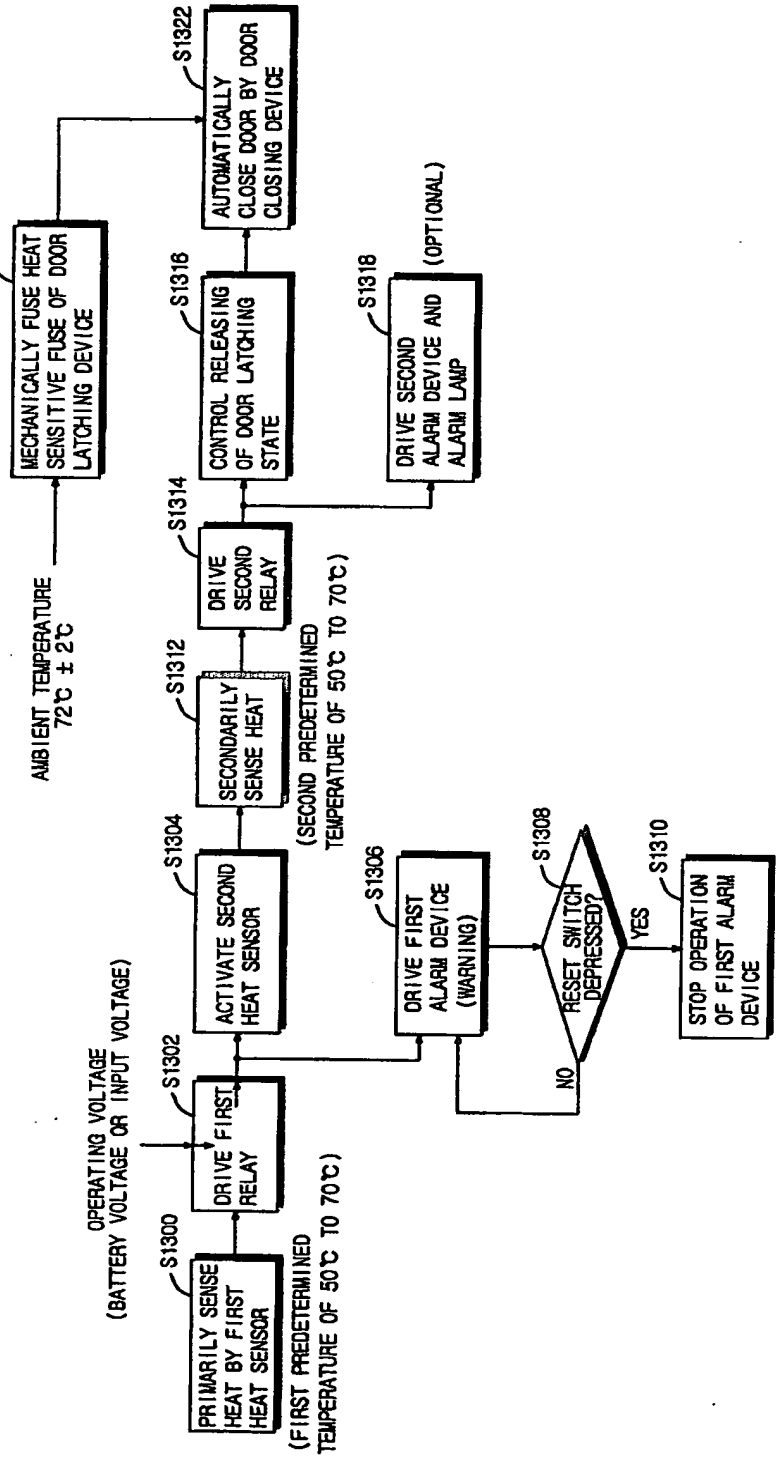

S1200
PRIMARILY SENSE FUMES BY FIRST FUME SENSOR
(FIRST PREDETERMINED FUME CONCENTRATION)
S1202
DRIVE FIRST RELAY
OPERATING VOLTAGE (BATTERY VOLTAGE OR INPUT VOLTAGE)
S1204
ACTIVATE SECOND FUME SENSOR
S1206
DRIVE FIRST ALARM DEVICE (WARNING)
S1208
RESET SWITCH DEPRESSED?
YES
NO
S1210
STOP OPERATION OF FIRST ALARM DEVICE
S1212
SECONDARILY SENSE FUMES
(SECOND PREDETERMINED FUME CONCENTRATION)
S1214
DRIVE SECOND RELAY
S1216
CONTROL RELEASING OF DOOR LATCHING STATE
S1218
DRIVE SECOND ALARM DEVICE AND ALARM LAMP
(OPTIONAL)
S1220
MECHANICALLY FUSE HEAT SENSITIVE FUSE OF DOOR LATCHING DEVICE
AMBIENT TEMPERATURE 72℃ ± 2℃
S1222
AUTOMATICALLY CLOSE DOOR BY DOOR CLOSING DEVICE

FIG. 15


S1300
PRIMARILY SENSE HEAT BY FIRST HEAT SENSOR
(FIRST PREDETERMINED TEMPERATURE OF 50℃ TO 70℃)
S1302
DRIVE FIRST RELAY
OPERATING VOLTAGE
(BATTERY VOLTAGE OR INPUT VOLTAGE)
S1304
ACTIVATE SECOND HEAT SENSOR
S1306
DRIVE FIRST ALARM DEVICE (WARNING)
S1308
RESET SWITCH DEPRESSED?
YES
NO
S1310
STOP OPERATION OF FIRST ALARM DEVICE
S1312
SECONDARILY SENSE HEAT
(SECOND PREDETERMINED TEMPERATURE OF 50℃ TO 70℃)
S1314
DRIVE SECOND RELAY
S1316
CONTROL RELEASING OF DOOR LATCHING STATE
S1318
DRIVE SECOND ALARM DEVICE AND ALARM LAMP
(OPTIONAL)
S1320
MECHANICALLY FUSE HEAT SENSITIVE FUSE OF DOOR LATCHING DEVICE
AMBIENT TEMPERATURE 72℃ ± 2℃
S1322
AUTOMATICALLY CLOSE DOOR BY DOOR CLOSING DEVICE

INTERNATIONAL SEARCH REPORT

ternational application No.
PCT/KR2003/002533

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 E05F 15/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 A62B 3/00, A62C 2/06, E05F 3/00, 3/22

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KR, JP : A62B 3/00, A62C 2/06, E05F 3/00, 3/22

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 79-000936 B1(Morida yosioe), 31, Jul, 1979(31.07.1979), Full text : Figs 1 to 31	1-31
A	KR 79-968 Y2(Nomibosaigogoe co. Ltd.), 30, Jun, 1979(30.06.1979), Full text : Figs 1 to 4	1-31
A	JP 11-159238 A (Kim, young-jo), 15, Jun, 1999(15.06.1999), Full text : Figs 1 to 13	1-31
A	KR 20-0279549 Y1(Je-il metal co. Ltd), 24, Jun, 2002(24.06.2002), Full text : Figs 1 to 6	1-31

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 FEBRUARY 2004 (02.02.2004)	02 FEBRUARY 2004 (02.02.2004)

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Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2003/002533

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 79-000936 B1	31.07.1979	None	
KR 79-968 Y2	30.06.1979	None	
JP 11-159238 A	15.06.1999	None	
KR 20-0279549 Y1	24.06.2002	None	